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[OFFICIAL NOTICE.]

Meeting of Council, American Association.

A meeting of the Council of the American Gas Light Association will be held in Parlor 20, of the Continental Hotel, Philadelphia, at 7:30 P.M., Tuesday, October 15th, at which the usual preliminary routine business will be transacted.

[OFFICIAL NOTICE.]

Twenty-third Annual Meeting, American Gas Light Association.

OFFICE OF THE SECRETARY, P. O. Box 1160,
PROVIDENCE, R. I., October 1st, 1895.

The 23d annual meeting of the American Gas Light Association will be held in Philadelphia, Pa., on October 16th, 17th and 18th, 1895.

The meeting will be called to order by the President, Walton Clark, of Philadelphia, Pa., at 9:30 o'clock, A.M., on October 16th, in the meeting hall at the headquarters, Continental Hotel, which is located on Chestnut street, corner of 9th.

The Continental is conveniently reached by the principal street car lines, as are the other first-class hotels in its vicinity. As the most satisfactory quarters are always obtained by writing in advance to the hotel people, the following list of hotels is appended, and it is particularly suggested that in writing to them a reply be requested, for which a self-addressed and stamped envelope should be inclosed, as misunderstandings and disappointments may thereby be averted. Remember: "First come, first served."

Hotel.	*Rates.*	*Distance from Headquarters.*	*Location.*
Continental (American plan). Special rates to those attending the Convention....	4th, 5th and 6th floors ... $2.25 3d floor .... 3.00 2d and 1st. 4.00 Rooms with Baths, extra.	This is the Headquarters.	Cor. of 9th and Chestnut streets.
Girard.....	.....	Directly opposite.	On Chestnut street.
Bellevue (European plan)...	$2.00 and upwards.	6 blocks.	Broad and Walnut sts.
Stratford (European plan) ..	$2.00 and upwards.	6 blocks.	Broad and Walnut sts.
Metropole (European plan)..	$1.50 and upwards.	7 blocks.	Broad and Locust sts.
Colonnade (European plan).	$1.50 and upwards.	6 blocks.	15th and Chestnut sts.
" (American plan).	$3.50 and upwards.	"	" "
Bingham (American plan)..	$2.50 and upwards.	3 blocks.	11th and Market sts.

The meeting hall had to be changed, as the original plan for the headquarters and hall could not be carried out, owing to the failure of the large hotels uptown to complete their house alterations in time for the convention. By special arrangements with the Continental it was made possible for the meeting to be held there, with the Ladies' Ordinary as the meeting hall; thus the sessions will be held at the headquarters.

Reduced rates for transportation have been secured, methods for obtaining which are given in detail at the close of this notice.

The Roll Call will be made by means of an improved system of door cards, in charge of one of the Committee of Arrangements. Each member upon entering the hall for the first time will at the door receive a special card upon which he will find his name, address, etc., the card then to be given to the doorkeeper after correct-

ing any errors on it. Members in attendance should attend to this very carefully, as these cards are used directly after the meeting in correcting the annual membership list. Visitors will please hand to the doorkeeper their personal cards.

Blank forms for application for membership will be found among the last pages of several issues of the *Quarterly Proceedings*, and may also be had, with full information, by addressing the Secretary.

Applications for membership must be indorsed by two active members and be received by the Secretary on or before October 5th, as if received later than that they cannot be constitutionally acted upon at this next meeting.

The list of papers to be read at the meeting is as follows:

"The Creation of a Healthy Public Sentiment Toward the Gas Company in the Locality in which it Operates," by Mr. W. H. Rogers, Paterson, N. J.

"Retort House Design and Practice," by Mr. A. E. Forstall, Newark, N. J.

"Notes on the Storage of Oil at Gas Works," by Mr. Frederic Egner, Norfolk, Va.

"The Ventilation of Gas Lighted Rooms," by Mr. Irvin Butterworth, Columbus, O.

"Bench Firing with Soft Coal," by Mr. E. G. Pratt, Des Moines, Ia.

"The Commercial Value of Photometry," by Mr. Alex. C. Humphreys, New York City.

In addition to these there will be, in the latter part of Wednesday afternoon, an illustrated lecture on Acetylene, by Mr. W. W. Goodwin, of Philadelphia, Pa.

Members are expected to send in not only papers on original subjects, but also written discussions or analyses of any or all of the papers written by others, such written discussions to appear in the next issue of the *Quarterly*.

Questions for the Question Box should be sent to the Secretary as early as possible, as each one will be referred to some member, who will lead discussion on it, and so it is very desirable that sufficient time be given for proper investigation of the subjects.

The Committee of Arrangements have about completed their programme, and the Secretary is allowed to say that it is expected to make the general programme as follows: On Wednesday forenoon, business session; Wednesday afternoon, business session, including illustrated lecture by Mr. Goodwin; Wednesday evening, it is expected to hold a ladies' reception, with music, at the headquarters. Thursday forenoon, business session, extending to probably 2 o'clock. Thursday afternoon the members, will, by special invitation, go to the Welsbach factory at Gloucester City, by boat, for an inspection of the plant and a most elaborate display of incandescent illumination in the evening. On the way to the Welsbach factory a short trip will be made up the river, showing Philadelphia's commerce and the famous Cramps' shipyards. A dinner will be served on the grounds of the factory by the United Gas and Welsbach Companies, a special pavilion being erected for the purpose. Friday, the Association will go to Atlantic City by special train, returning same afternoon. Headquarters while there will be at the newest and best hotel, an excellent dinner will be served, and the members will have a good opportunity to visit this famous coast resort. The ladies will be well cared for, as usual. Meet each other Wednesday forenoon, gossip and shop rest of the day; reception in the evening. Thursday, drives and gossip; theater parties in the evening. Friday, trip to Atlantic City.

During the days of the meeting bulletin boards will be posted in the lobby of the headquarters and in the meeting hall. All members are warned to take due notice thereof and govern themselves accordingly, that they may be apprised of any change in or addition to the programme.

Each member is particularly requested to wear his badge of the Association in plain sight during the meeting, thereby affording the officers and committees of the Association, as well as others requiring it, a means of recognition, thereby greatly facilitating the work of the meeting and particularly of the Philadelphia Committee.

Many of the members have allowed their dues to remain yet unpaid, and this is a source of much difficulty and extra work to the Treasurer, who has already sent several statements to each of the delinquent ones, as you must know if you are one of them, unless you have failed to notify him of change of address.

Extracts from the Constitution.

Sec. 12. Application for Active Membership, or for Associate Membership, or for transfer from Associate to Active Membership, must be received by the Secretary at least ten days prior to the meeting at which the application is acted on.

Sec. 51. No member who owes two years' dues shall be entitled to vote, or to participate in the deliberations of the Association, or to receive a copy of the proceedings.

Sec. 52. Any member whose dues shall remain unpaid for a term of three years, may be dropped from the roll of membership by a vote of the Council. Respectfully, A. B. Slater, Jr., Secretary.

BRIEFLY TOLD.

This Week, at Philadelphia.—Everything is as it should be in connection with the advance arrangements for the meeting of the American Gas Light Association this week in Philadelphia, which means that the Association's executives and the local committee of arrangements have seen to it that nothing has been left undone on their parts to insure the comfort and entertainment of those who will personally share in the Association's 23d convention. So far as we can see, the indications all point to a most successful meeting, since the gas men who have looked in on us at 32 Pine street, during the past month or more, were unanimous in their saying that Philadelphia, in mid-October, would house them. Technically, the meeting is bound to be a success; for the paper list is exceptionally promising, in that it is, so far as one may judge, because of its diversification, naming many subjects that have not hitherto been discussed at our Association meetings. A glance merely over the titles of the promised papers would seem to create antagonism to this verdict, but a study (neither long nor profound) of them will show that new matter will follow the "old" headings. For instance, there is Mr. Egner's paper on "The Storage of Oil at Gas Works," a theme which should greatly interest the sage proprietors of the Standard Gas Light Company, of New York. Indeed, Mr. Egner's communication is twice opportune and doubly worthy of appreciation, for, as oil is increasing in value, the necessity of confining it safely by means of sound, tight tanks is apparent. Mr. A. C. Humphreys, too, looks to have taken to himself an easy subject—easy in the sense that we have heard about it in one form or another ever since a stable artificial lighting medium has been supplied from a central station—but we have yet to hear or know of another author who had the courage to discuss photometry from a commercial standpoint purely. Nor can we think of another man in the gas industry better qualified to speak understandingly on the topic. Beginning his practical career in the industry with those who forced railroad companies in this country to acknowledge the superlative merits of the Pintsch system of moving car illumination, and his later connection with the water gas industry in the States and abroad, no one more than he may tell us authoritatively what photometry means, when its teaching is applied for the establishing therefrom of a commercial value of rating. He would be looked at askance, who, 20 years ago, told us that bench firing with soft coal would be possible in the States, in point of economy, still Mr. Pratt means to show how it has been successful at Des Moines. The other papers, too, although titularly familiar, are quite sure to hold the attention of the meeting, for Mr. Forstall is certainly an authority on bench practice, a practice that is not by any means so much out of date as some would have others to believe. Mr. Rogers, of Paterson, N. J., has selected a theme that would seem to be well worn, but as his success in keeping his patrons in line in his home town has been, and is, appreciated by the United Gas Improvement Company, which concern knows full well the trouble experienced by it in making matters straight in the early days of proposed amalgamation there. So, as far as one may look ahead, the paper programme is all right. The fine executive hand of Col. Barrows may be trusted to keep interlopers away from the Welsbach Company's exhibit at Gloucester, and the Committee of Arrangements is quite up to seeing to it that the glories of Atlantic City, in mid-October, will be thoroughly enjoyed. In fact, it looks that the Quaker City meeting of the central representative gas body is to be a success complete.

Notes.—Mr. Bankson Taylor has been appointed Superintendent of the Elerslie Gas and Coke Company. The Company's manufacturing plant is located at Winifrede Junction, W. Va., and the executive offices are in 508 Walnut street, Philadelphia, Pa.——"E.P.C.," writing under date of the 5th inst., from San Francisco, says: "Mr. M. C. Osborne, formerly Superintendent of the works at Virginia City, Nev., has been appointed Superintendent of the Santa Cruz (Cal.) Electric Light and Power Company, which concern has succeeded to the property of the Santa Cruz Gas Company. It is also understood and acknowledged by the Los Angeles oil syndicate that the Standard Oil Company now controls the output of all the main producing wells in Los Angeles."

An Improved Portable Photometer.

[A paper read by W. H. Preece, F.R.S., and A. P. Trotter, B.A., before the Mechanical Science Section of the British Association.]

When light falls upon a surface, that surface is said to be illuminated. The illumination depends simply upon the light falling upon the surface, and has nothing to do with the reflecting power of the surface, just as rainfall is independent of the nature of the soil. As a rain gauge receives the full amount of rain when it is placed horizontally (disregarding wind), and receives less when it is tilted, so the surface is fully illuminated when it faces the source of light, and is less fully illuminated when the light falls upon it at an angle. The proportion between the full rainfall or illumination and the measured rainfall or illumination varies as the cosine of the angle of incidence of the rain or of the light. The angle is 0° and the cosine is 1, when the rain gauge is placed horizontally, or when the light falls perpendicularly upon the surface. It would perhaps be unnecessary to call attention to these very elementary matters, were it not that difference between the photometry of illumination and the ordinary photometry of candle power is often confused.

The lighting of streets and of buildings may be specified by the maximum and minimum illumination. The primary purpose of an illumination photometer is to measure the resulting illumination produced by any arrangement of lamps, irrespective of their number, their height or their candle power. Illumination photometers containing sub-standards of light have been designed by Professor Weber, Professor Mascart and others. One of us described an illumination photometer before the Royal Society in 1883.[1] This consisted of a box blackened within. Over the end was stretched a Bunsen screen of paper, on the middle of which was a grease spot. At a distance of 12 inches was another screen, of drawing paper. The grease spot was so screened that no light fell upon it, except that which was reflected from the drawing paper screen. At the end of the box opposite the Bunsen screen was an eyepiece, consisting of a plain tube. Within the box a small glow lamp was fixed; and in order to make a measurement of the illumination of the drawing paper screen, the current through the lamp was varied through a rheostat until the grease spot was invisible. The readings were recorded in "luces"—a "lux" being suggested by one of us at the Paris Electrical Congress, 1889, as the name for the illumination due to a Carcel lamp at 1 meter, and equivalent to a British standard candle at 1.058 foot. The only defect of this photometer was the yellowish and reddish color of the lamp when dimmed for low readings.

In 1884, we designed a portable photometer,[2] in which the lamp could be moved towards, or withdrawn from, the Bunsen screen; and mechanism was provided by which, when a pointer moved a certain distance over a uniformly divided scale, the displacement of the lamp was as the square of that distance. The Bunsen spot was viewed by Rudorff mirrors, in the usual way. This instrument worked well; but the range was small, and could not be easily increased. The lamp would have to be moved to a considerable distance from the screen, for measuring the feeble illuminations met with in street lighting.

Eight years later, one of us experimented with modifications of this instrument, and found that, in ordinary street lighting, the illumination is often only equal to that due to 1 candle at 14 feet distance. A large number of different methods of reducing the light were tried. Many combinations of lenses, the eclipsing device used in dissolving views, photographically shaded glass screens, and other devices were employed. Finally, a white reflecting screen was inclined at different angles to a small electric lamp; and on this principle a photometer was constructed in February, 1892. It was found that the Bunsen screen could be replaced with advantage by a simple white cardboard diaphragm, pierced with one or more holes. The illumination of this diaphragm, generally in a horizontal position, was the illumination to be measured. Below this was the reflecting screen, inclosed in a box about 2 ft. by 6 in. by 5 in., with a pair of small glow lamps and a secondary battery. The screen could be inclined towards the glow lamps by means of a chain wound up on a cam mounted on a spindle, the cam being formed so as to give an open scale. A hand or pointer indicated readings on a dial. Many measurements and a number of photometrical surveys of different streets and public buildings in London were made in 1892, and are recorded by means of plans with isophotal contour lines and otherwise.[3]

During the present year an improved form of this photometer has been constructed. The chain and cam, which allowed the instrument to be used only in a horizontal position, have been replaced by a system of levers. The object of these levers is to give an open scale. If the motion of the pointer were proportional to the angular movement of the screen, the scale would be approximately a scale of cosines. The instrument is shown in Fig. 1, with the lid open and the front let down. It measures 1 foot 3¾ inches by 5½ inches, and is 9½ inches high. On the end to the left there is a red glass window, and immediately within are two 12-volt lamps (one of which is shown in Fig. 2)—one of about

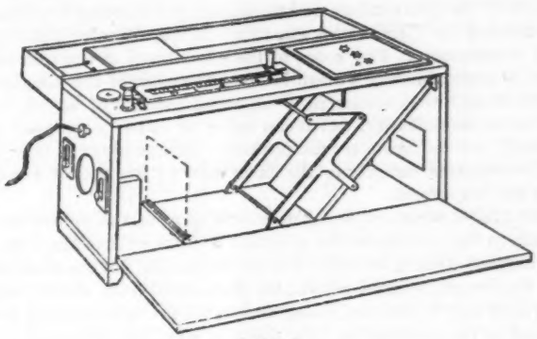

Fig. 1.

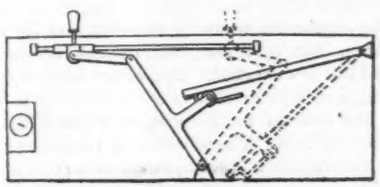

Fig. 2.

1-candle power, and the other of 2-candle power. It can be seen through the window if either or both of the lamps are alight. The lamps are held in special lamp holders, capable of adjustment as to height by clamping screws. These screws and the base of one of the lamp holders are shown in Fig. 1. A switch on the top of the instrument enables either or both of the lamps to be turned on or off. At the other end of the box the reflecting screen is hung. The middle of the screen is about 11 inches from the lamps. It is shown in Fig. 1 in its lowest position. In Fig. 2 the screen and one of the levers, together with one of the rollers on which the screen rests, and the handle by which it is moved, are shown with the screen in its highest position by full lines, and in its lowest position by dotted lines. In its highest position the filaments of the lamps are a little below the plane of the screen. No direct light from the lamps then reaches the screen, and it is only faintly illuminated to about $\frac{1}{100}$ of a candle at a foot, by stray light, which is excluded as much as possible.

The diaphragm is placed horizontally immediately above the hinged screen. Three small star-shaped holes are cut in it, and through them the illuminated reflecting screen can be seen. A handle carrying a pointer, moving over a graduated scale, controls the inclination of the screen by means of the levers and links. A guide attached to the back of the screen (shown in Fig. 2) allows the instrument to be turned on its side without interfering with the working. In order to take a measurement, one or both of the lamps are turned on, and the handle is moved till the screen seen through the holes in the diaphragm matches the diaphragm in brightness. If the color of the light outside is about the same as that of the lamps, the middle hole may be made to disappear. The observer should stand approximately in the vertical plane passing through the three holes, so that he may see that part of the screen through them which lies immediately beneath them.

Various substances have been tried for the diaphragm and screen. Thin metal, painted with a whitewash made of magnesia and isinglass, is perhaps the best. The diffused reflection practically follows Lambert's cosine law; but the material is easily soiled, and cannot be cleaned. Bristol board from which the glaze has been removed by a damp cloth, closely follows the cosine law within the angular range required in this case. It is important that there should be no glaze on the surface of the hinged screen, since the inclination of the lamp to the screen, and of the screen to the eye for maximum illumination, is about 45°. But as the scale is graduated by experiment, a slight departure from the cosine law does not matter. On the other hand, it is of

1. Proceedings Roy. Soc., 1883, Vol. XXXV., p. 39; and Proceedings Inst. C.E., Vol. CX., p. 98.

2. Proc. Inst. C.E., Vol. CX., p. 101.

3. Proc. Inst. C.E., Vol. CX., pp. 42-51.

greater importance that the screen should be very smooth and flat. Under very feeble illuminations, the light from the small lamp making an angle of incidence very nearly 90°, minute irregularities are easily seen, and make accurate readings difficult. For ordinary street lighting and for general industrial photometry, a slight departure from the cosine law on the part of the diaphragm is of no practical consequence, so long as there is no perceptible glaze, for it is always observed nearly vertically, and never at a large angle.

The color difficulty is reduced, in the first instance, by the freedom of motion of the levers. The handle may be quickly moved to and fro on each side of the true reading, and the middle position may be estimated. In measuring the illumination due to arc lamps, the color difficulty becomes troublesome. The color of the glow lamp in the photometer should be approximately a mean between the color of the standard of light wherewith the instrument is calibrated and that of an arc lamp. This halves the difficulty, which can never be entirely removed, since differently colored lights are not physically comparable. It may, however, be relegated entirely to the laboratory by the use of a colored screen and diaphragm.

If the hinged screen be tinted pale blue, some of the yellow rays of the lamp in the photometer are absorbed, and the reflected rays approximate to gray—that is, to feebly illuminated white. On the other hand, if the diaphragm is tinted yellow, the white light from electric arcs or of daylight may be reduced to approximately the same color as that of the lamp in the photometer. In the first case, the brilliance of the hinged screen is reduced, and a brighter lamp would have to be used to restore the true value of the scale readings; and in the second case, the brilliance of the diaphragm would be reduced, and the scale readings would be too high. But, by tinting both screens, the calibration of the instrument need not be disturbed. The screen being colored pale blue and the diaphragm pale yellow, there is no difficulty in obtaining disappearance of the hole in the diaphragm when illuminated by arc light, or even by daylight. The selection of the colors suitable for obtaining a true measurement is based upon the mean of a number of measurements. White screens are used, and the comparison should be made in a building illuminated with a number of arc lights. A number of measurements are made with quick oscillations of the handle, and the mean is taken. Several screens and diaphragms of different tints being in readiness, pairs are tried, and a selection is made of a pair which give a good color match, and, if possible, the mean reading given by the white screens. A slight departure from the mean could be corrected by the use of a coefficient. It is not suggested that strongly colored lights can be scientifically compared in this manner, but only that the yellowish light of a glow lamp may be compared with the whitish light of an arc or of subdued daylight. We employed this device in 1884, and Messrs. G. W. & M. R. Patterson, the translators of Palaz's "Industrial Photometry," who have used it in connection with a Lummer-Brodhum photometer, remark that "it can, of course, give no additional absolute accuracy to the photometric measurements. It, however, adds greatly to the comparative accuracy of the results, as it makes it possible to measure relative intensities under various conditions with great precision." But it should be observed that the selection of the tints may be made at leisure, and under favorable laboratory conditions, and by thus avoiding all color trouble during the ordinary use of the photometer, a very considerable gain in precision is secured.

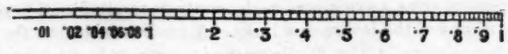

Fig. 3.

The scale is 5½ inches long, and is shown in Fig. 3. With the smaller of the two lamps, the highest reading is equivalent to 1 candle at a foot; with the larger lamp it is twice this illumination. The oscillations of the handle generally extend, at first, over two scale divisions, and after three or four oscillations their amplitude may be reduced to about one scale division. The half of a scale division may be estimated, except at the highest part of the scale, which is slightly contracted. The precision is about 2 or 3 per cent. The contraction of the upper part of the scale is intentional, and is caused by the arrangement of the levers.

In case of renewal of the lamps, it is very important that other lamps should be placed in exactly the same optical position in the photometer, otherwise the scale would have to be re-calibrated. In order to fix the height of the lamps, which is the only adjustment necessary, a sheet metal screen (shown by dotted lines in Fig. 1) is placed in a holder attached to the floor of the photometer. Two small holes are drilled in this screen, and a white paper screen, having a black horizontal line, is fastened to the end of the box (see Fig. 1) opposite to the lamps. The hinged screen being lifted by the levers out of the way, "pin-hole images" of the filaments are thus thrown on to this screen; and the lamps being set (see Fig. 2) so that the single horseshoe filament appears nearly closed up, the dark line between its two limbs is made to fall on the black horizontal line. The images being magnified, considerable accuracy is possible.

Although the principal object of this photometer, as of those which preceded it, is the measurement of illumination, it is sometimes desirable to measure the candle power of a lamp in the street without removing it from its position. By the use of a graduated arc, such measurements can be made with the present photometer. A quadrant is fastened to the side of the photometer; and a pin at the center, from which the quadrant is struck, acts as a gnomon. A spirit level on the top of the instrument being adjusted, the angle of incidence may be read in degrees on the quadrant, and at the same time the cosine of this angle may be read on an adjacent scale. It is necessary to find the slant height or direct distance from the source of light to the photometer.

To measure the vertical height of the light, set the photometer so that the shadow falls on 45°. Measure the distance from the pin to the lamp horizontally, and from the pin to the ground vertically. The sum of these distances is the height of the actual source of light. This can be measured to about 2 per cent.—say, 3 inches in 12 ft. 6 in.

To find the slant height at any distance, the height of the light being known, divide the height of the lamp above the photometer by the cosine of the angle of incidence; the quotient is the slant height required. Or the horizontal distance may be measured, and the square of this distance added to the square of the height of the light. This gives the square of the slant height.

To find the candle power, the illumination in units of a candle at a foot being observed, the light from other lamps being carefully screened, and the slant height being known. Multiply the illumination by the square of the slant height, and divide by the cosine of the angle of incidence.

On hilly ground, it is necessary to know the height of the lamp above the photometer at each point of measurement. It is best, in that case, merely to record the angles, and afterwards to find the tangents. The horizontal distance between the photometer and the lamp post, divided by the tangent, gives the required height.

It may be observed that, when the square of the slant height in feet is equal to the cosine of the angle of incidence, the scale graduated in units of a candle at a foot becomes a scale of candle power, and when the square of the distance in feet is 10, or 100, or 1,000 times the cosine, the multipliers, 10, 100, or 1,000 may be used to convert it into a scale of candle power. The square of the slant height being known, the photometer may be tilted until the required cosine is indicated by the shadow of the pin. If the slant height is measured by the sum of the squares of the horizontal distance and the height, the square is at once obtained.

We have calibrated our photometers either by standard candles, or by sub-standard glow lamps supplied from secondary batteries, or by the amyl-acetate standard lamp or Hefner unit. This standard (which is well recognized in physical work) is 0.877 of a standard candle; or a standard candle is 14 per cent. more than an amyl acetate lamp. Placed at 1 foot distance from , and perpendicular to, the diaphragm, the photometer being placed on its side, the illumination is 0.877 of a candle at a foot. If it is brought to a distance of 11¼ inches ($\sqrt{0.877}$ foot,) it is equivalent to 1 candle at a foot. But this distance and position are inconvenient. If it is placed at a distance of 1 foot, and at an angle of 55° 10′, the illumination on the diaphragm is one-half of a candle at a foot, since cosine 55° 10′ = 0.57, and $0.57 \times 0.877 = 0.5$. A mark is therefore made at this angle on the quadrant, and inscribed "H.U.= ½ c.p."

Considerable experience with the use of small glow lamps supplied from portable secondary batteries has given us great confidence in this kind of secondary standard of candle power. The battery is always freshly charged before each evening's work, and is discharged for half an hour before use. The lamps are only turned on while an observation is being taken.

The 1893 photometer was arranged to be held in the hand; our 1884 photometer stood on a tripod about 2 ft. 6 in. from the ground. The street measurements in 1892 were all made with a photometer placed on the ground; the diaphragm being about 6 inches from the pavement. The proper height for an illumination photometer is a matter of opinion. When the photometer is placed on the ground, the large number of measurements required for a thorough photometric survey of a street or an empty building can be quickly made. For some purposes—for example, in an exhibition or a church—a stand is necessary. The calculations of candle power then become rather more tedious.

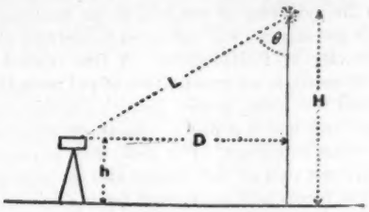

Fig. 4.

The various observed and computed quantities may be expressed as follows:

D = horizontal distance from photometer to lamp post (see Fig. 4).
L = slant height from photometer to light.
H = height of light above the ground.
h = height of photometer diaphragm from the ground.
θ = angle of incidence.
c/f^2 = illumination of units of a candle at a foot.
c.p. = candle power.

Then—

$$H - h = D \div \tan \theta;$$

$$L = [H - h] \div \cos \theta = \sqrt{D^2 + [H - h]^2};$$

$$\text{c.p.} = (c/f^2 \times L^2) \div \cos \theta.$$

The following is an example of the measurement of the illumination and candle power in the case of a street lamp:

D	θ	c/f^2	tan θ	cos θ	H—h	H	L	L^2	$c/f^2 \times \cos \theta$	c.p.
20	66°	0.025	2.25	0.407	8.9	11.9	21.8	475	0.0614	29

Mr. Westinghouse on the Likelihood of the Generation of One Horse Power from One-Half Pound of Coal.

[From the New York Correspondence in the Philadelphia *Press*, of date of October 2d.]

When Col. Hain, the manager of the New York Elevated Railroad system, went to Pittsburgh late in the spring, that he might investigate the electric systems used in the Westinghouse yards, he was very greatly impressed with the demonstration there made of the capacity of electric current to move swiftly, easily and economically the freight trains that had been taken into the yard, But when Col. Hain came to talk with Mr. George Westinghouse, Jr., about the commercial advantage to the elevated system to be found in substituting electricity for the motive power in these roads he was perhaps a little surprised to find that Mr. Westinghouse was not at all urgent in advocating such a substitution. This seemed all the more remarkable since the system in use in the yards in Pittsburgh is controlled by the Company of which Mr. Westinghouse is President, and a contract between that Company and the Elevated Railroad people would involve a very large amount of money. Mr. Westinghouse, however, said to Col. Hain that, while he was satisfied that rapid transit in New York, as in other cities, would sooner or later make use exclusively of electricity as the motive power, nevertheless he felt that in view of certain important things which he had in mind, and the nature of which he was not then able to suggest, it would be well for a corporation of so much capital as the Manhattan Elevated to wait a little while before deciding upon the electric system which it would be commercially advantageous to use.

That suggestion of delay was so remarkable that I asked Mr. Westinghouse in the spring if it were true, as reported, that he had made it, and he replied that it was a correct statement. He then said that he was convinced that within the next twelve months some developments of the utmost importance—possibly revolutionary in their nature—relating wholly to the production of electricity, not only as a motive power, but as a general servant, would be made. Those developments were of such nature that at that time Mr. Westinghouse did not feel free even to indicate what they might be. A little later there came the news of the combination of the Westinghouse Company with the Baldwin Locomotive Company, and it was thought that possibly it was this that Mr. Westinghouse had in mind when he suggested that there might be revolutionary developments within the next few months.

But it was not this at all. The combination of the Baldwin people with the Westinghouse concern is a mere commercial incident in comparison with the solution of that great problem which Mr. Westinghouse believes to be near at hand. That solution cannot but most importantly affect the Westinghouse-Baldwin combination, as it will affect probably the development and use of electricity everywhere in the world.

The Gas Engines.—Little engines had been made in Europe, and a few in this country, which by the use of coal gas in a vacuum or cylinder were able to furnish a moderate power, and even in Europe an engine so great as one developing 350-horse power and driven by this force was built. But that and the others were simply engines designed to take the place of the ordinary steam engine, and there was no evidence furnished to the commercial world that these offered any great economical advantage over steam engines.

Three or four years ago two scientific and mechanical experts were sent to Europe to make a study of the gas engines in use in England and on the Continent. Some of the greatest scientists of the world had in confidential communication suggested that possibly these engines might furnish the hint for the solution of perhaps the greatest problem modern civilization has had presented to it—the obtaining of direct energy from coal. The experts returned after a long sojourn abroad, and then were instructed by some of the greatest capitalists of this country to make plans, if they could do so, for gas engines which would be able to take the place of those driven by steam power.

It is not possible in this article in any greater detail to suggest what the work of these experts was than to say that after a year or more of the most careful labor they were not able to make suggestions which seemed to the capitalists of any value. Then Mr. Westinghouse took hold of the problem. How long he thought about it he only knows, but it was while he was turning it over in his mind that the suggestion came to him that if the suitable engine could be built it would solve the problem of the economical use of the power that is in coal, and such use of it as could be transferred to an electric current.

However that may be the results of his own contemplation of the subject, and of the expert aid which he has been able to command, have been such as to justify Mr. Westinghouse in making the assertion, as he does now through the *Press*, that we are probably upon the eve of the greatest commercial revolution this country has ever known and one which will enormously increase its wealth, as well as aid the people by giving them comforts and conveniences which have in the past been believed to be only possible for those who are very wealthy.

The Direct Energy of Coal.—Five or six years ago Mr. Edison, in a chat with a *Press* correspondent, said that when he had developed successfully his idea for the extraction of magnetic ore, he should undertake to solve the problem of obtaining directly the energy that is in coal. He then said that if this problem could be solved it would probably result in increasing the wealth of the civilized world to a greater degree than any other influence of civilization had ever done, and would far exceed the advantages to the world which had flowed from the discoveries of Bessemer for the making of steel. The Bessemer service to the world has been estimated by ex-Mayor Abraham S. Hewitt to be equivalent to an addition to the wealth of the world in the past forty years by a sum equal to the entire commercial capital of the civilized world a hundred years ago. Edison said that if it were possible to obtain directly the energy that is in coal the wealth-increasing results would far exceed those due to Bessemer's discovery. For instance, he declared that if all the power there is in coal could be directly utilized, an ocean steamer would cross from Liverpool to New York with an expenditure of only 200 or 300 tons of coal, whereas now so much as that is used in a single day. The factories would be able to get from a pound of coal the power which the steam engine develops only from 100 pounds. Of course, everyone could see that that would result in an enormous cheapening of the most important expense next to labor, perhaps, and materials, involved in any manufactured article.

Mr. Edison's computations were that in the development of steam power 90 per cent. of the coal used under the boilers is dead waste. The heat goes up the chimneys. It is felt in the boiler rooms, and out of a hundred pounds of coal 10 create the power necessary for modern civilization, while 90 goes to waste. If any considerable portion of that 90 per cent. of wastage could be saved the reduction of cost would be almost incalculable.

The solution of this problem has been the dream of scientists for a good many years. They have known that the man who solves it will gain fame and probably a great fortune, perhaps comparable with the $20,000,000 which was Bessemer's pecuniary reward for his discovery. Many attempts have been made to solve it of which the world has never heard. A few miles out of the city for more than a year enthusiastic young scientists have been giving their whole time to investigations which they hoped would lead to a solution of this problem.

Meanwhile, Mr. Westinghouse, taking up the work which experts left incomplete, and not thinking so much about the solution of the problem of procuring directly and economically the energy which is in coal, has constructed an engine. It is of 100-horse power, and within the next week or two it will be used at the Westinghouse works in Pittsburgh for the development of the electric current used in the switching and transfer of cars on the mile and a half of tracks in those yards. This engine is a gas engine, and, as hereafter will be shown, it is expected that it will develop the equivalent of a horse power for expenditure of a little over half a pound of coal, whereas, heretofore, the experts have estimated that it would require 5 pounds of coal for such development.

But the mere building of this engine and its use in these yards for the creation of electric power would not be of very great importance were it not for the fact that it is regarded as merely a demonstration of what is possible. The scientists have not agreed upon the unit which it is advantageous to adopt for engines in the development of electricity. Some of them have placed the figure as low as 100-horse power. Mr. Westinghouse does not commit himself. Yet he is not likely to deny this assertion of the *Press*, that it is to-day his opinion that engines of 1,000-horse power may be built with economical advantage. However that may be, the experiments will be made, and it is probable that after this 100-horse power engine is placed in use in the Westinghouse yards, another of 500-horse power will be built, and after that one of 1,000-horse power. So confident are the Westinghouse people of the commercial value of this new departure that I am able to say that they expect in the near future that their great plant at Pittsburgh will have abandoned steam power, and will have made use of the gas engine whose power will be transformed into an electric current sufficient to drive those great works.

Mr. Westinghouse's Views.—Mr. Westinghouse is one of the most modest of men, and it was with a great deal of reluctance on that account that he granted me the interview, lasting several hours, in which these facts were obtained. But as he at last forgot, in his scientific and commercial enthusiasm, that he was practically talking to the *Press*, he became unrestrained, and spoke with the zeal and excitement of a great discoverer of these things which he believes to be now at hand. He said, for instance, that he was entirely willing to go on record as recording his belief that the developments in the production of electricity heretofore produced through the instrumentality of the steam engine are likely to be immediately of the most important character, and to secure an industrial revolution of vast proportions. And when he was asked what he meant by that he said that he meant that millions of tons of coal now annually wasted by the development of steam power are going to be saved, and saved in such a way that in addition to the economies effected, our communities are to be free from the nuisances of escaping gas and black smoke. That means that Chicago, Cleveland, Pittsburgh, Cincinnati and other great cities of the West, which have been shadowed for so many years by these palls of bituminous smoke, are going in the near future to be freed from that annoyance. Furthermore, it means that the electric current within the next year or two is going to be so cheaply furnished that it will serve all the purposes of power as well as of lighting and heating.

Mr. Westinghouse went on to say that when coal is turned into electricity the useful heating effect through the medium of the steam engine and electric generator is only secured by an expenditure of from 10 to 12 pounds of coal burned under a boiler, when one pound of coal would serve equally well in all ordinary household appliances. The most careful statistics show that it requires an average of 5 or 6 pounds of coal per hour burned under a boiler for each electrical horse power generated and distributed, and that, of course, is an enormous wastage of coal.

The new development is going to make it possible to get the same results by the consumption of one-half to three-quarters of a pound of coal. Mr. Edison's statement that 90 per cent. of coal is wasted in developing power or light is confirmed by Mr. Westinghouse, who now believes that with these new engines it will be possible to utilize more than 50 per cent. of the energy which is in coal—a difference of 40 per cent. in favor of these engines. It should be said right here, by the way, that the construction of engines utilizing gas is open to the world. There are no special privileges or monopolies enjoyed by the Westinghouse Company. Mr. Westinghouse expects that with the revelations to the world of the capacity of gas to make electricity with economies of 50 per cent., there will be the same concentration of mechanical study upon the development of the gas engine which we have for the past 40 years seen in the building of the steam engine. Therefore there can be no puffery or advertisement of Mr. Westinghouse's plans, for the field is open to the world.

The New Force.—The probabilities are that the development which will be seen in the next year or two will be the establishment of central stations wherein gas engines are employed for driving electrical generators. Take the city of Philadelphia. A few central stations of this kind can, it is believed, at an expenditure of not more than five-eighths of a pound of coal per horse power, furnish Philadelphia with all the power, light and heat which it needs. In these stations gas producers will be used in place of boilers. The coal will be converted into producer gas. It will not pass off into smoke and invisible gases, as is now the case, but these forces will be retained for the driving of the engines. The impression is that at least 50 per cent. of the heat value of coal can thus be turned into an electric current, and distributed without considerable loss, and in fact be so effectively utilized that, to say nothing of power, heating by electricity will become as universal within the next three or four years as lighting by electricity now is. In fact, it is the opinion of the capitalists that these new developments will make the manufacture of illuminating gas within the next three or four years practically as much of a lost art as whale oil lamps.

The Kind of Coal.—For the production of the gas for these engines a coal of much poorer quality and lower cost can be used than is now necessary for the steam plant, and as no smoke is produced bituminous coal can be used most advantageously. It was said during the interview that a kind of culm which is an almost refuse product in Scranton can, by mixing with a higher grade of coal, be marketed in New York for $1 a ton, and be perfectly adapted for the generation of gas for these new engines. That, if the estimates are correct, will make it cost to produce 1-horse power only a fraction of a cent, or for an engine of 150-horse power, probably not much over $1 an hour—a statement which seems almost incredible, but which, nevertheless, is believed to be well within reason.

The revolutionary effect of the production of a horse power from three-quarters of a pound of coal per hour can only be suggested by some comparisons containing figures. Where power is delivered every hour of the day for 300 days of the year, only 3½ tons of coal per horse power will be required, and if the power is delivered only during the ordinary working hours of the day, only 1¼ tons per horse power per year are necessary. With the steam engine as many as 7 tons are needed. The quality of coal which can be used in the Middle and Eastern States ranges from 75 cents to $2.50 a ton, so that the cost of fuel for each horse power a year would range from $2.33 to $8.75. When, however, the power is only used for half the time, as for general manufacturing purposes, the price for fuel would be according to the coal used from $1.16 to $4.57 per horse power per year. A ton of the best gas coal converted into illuminating gas will operate 2,000 16-candle power gas jets for one hour. A ton of much inferior coal, costing less than half the price of the gas coal converted into gas, will through a gas engine and generator develop electricity enough to operate 26,000 16-candle power lamps for one hour.

The Problem of Illumination.—When the early experiments of Edison with electricity as an illuminator were being discussed, there was considerable alarm because it was feared that electricity might wholly supplant illuminating gas. But it was found that the general effect of the use of electricity for light was to create a new standard, making almost every individual desirous of more light; and besides that, there was a distribution of gas for heating purposes. The great cost of the distribution of the electric current by means of the direct current system operated itself in favor of the continued use of gas, but now that Tesla, with his discoveries and the use of the alternating and multiphase currents has overcome this cost, the current can be distributed, it is believed, with more than successful competition with illuminating gas. Gas will be used to generate the electric current, and its service there will probably be supreme, so that into houses where electricity is carried for lighting, heating or other purposes, it simply represents a conversion of gas into electric current, and conversion by means of the gas engine, which, utilizing 50 per cent. of the energy which is in coal, will make that current perhaps as cheap comparatively as was the tallow candle in the early days.

Its Relation to Railways.—The bearing of these radical changes, which are now believed to be sure to come, in the development of electricity in the operation of railways, it is almost impossible fully to conceive. Mr. Westinghouse says that he cannot adequately suggest the enormous results of the revolution. So far no form of locomotive has yet been secured that can be operated with less than 5 or 6 pounds of coal per horse power per hour. When, however, a horse power can be obtained from one-eighth of the coal now used on locomotives, it is probable that all hesitation on the part of railroad managers with respect to the adoption of the electric current as the motive power will be

at an end. Stations for the generation of electricity to be utilized for the operation of electric locomotives by means of the Tesla system for the transfer of power of high tension alternating currents will be established.

One of the most suggestive comparisons can perhaps be made by reference to the Manhattan Elevated Railroad. On that line anthracite coal is exclusively employed. The company requires for its locomotives 200,000 tons of coal a year, costing $800,000. It is now demonstrated to the satisfaction of the capitalists that with electric power developed by gas engines such as the one which is to be put into operation in the Westinghouse yards a few days hence—that engine being placed in a central station somewhere along the river front—it will be possible to furnish all the power the elevated road needs with 50,000 tons of coal, which would cost only $125,000 a year, which would make an annual saving in fuel alone of $675,000. That, according to commercial estimates, would justify an outlay of $6,750,000 for a change in equipment. It was probably these considerations which led Mr. Westinghouse last spring to suggest to the elevated railroad people that it might perhaps be well not greatly to hurry the consideration of a change from steam to electricity.

If there should be central stations established for the conversion of coal into electric power, light and heat in those cities in the West which are now darkened by smoke, the whole problem of cleanliness would be solved.

The experts do not claim that heat from electricity, even when generated by gas, can be as effective as direct heat from coal when burnt in the best possible manner, but they do believe that as the heat from electricity can be taken to the exact point of greatest usefulness, thus preventing loss, there is no doubt that the cost of electric heating under this new development will be so reduced that it will supersede all other methods of heating.

Certainly in metallurgical operations the use of the electric current is bound to be enormously expanded, and with a very great cheapening of cost, for when electricity is produced from one-tenth of the coal heretofore necessary, it is fair to believe that it will have a very important relation to the development of the iron industry.

Its Scientific Importance.—From a scientific point of view the Westinghouse developments will be regarded with the highest interest, because they in a great measure solve that great problem of the conservation of the energy that is in coal. But the commercial results are beyond the power of any man more than faintly to suggest.

The first indication of this new development will, as was said, be made at East Pittsburgh on property adjoining the great shops of the Westinghouse Electric Company. There the Westinghouse people are just finishing the 100-horse power gas engine which it is expected will develop its power from only a fraction of the coal required for a steam engine. Certainly it is not injudicious to say that in this new departure of such vast importance there may be results far greater than have followed up to this time the establishment of those great commercial works. There it is expected that within a short time the world will see such practical operations as will show that such cheap production of electrical power has been procured as to make it certain that this force will be the chief, and perhaps the only one, to serve mankind for power, light and heat.

The development of gas engines will, of course, most importantly supplement the use of water power for the creation of electric current. For if it is possible to make a central station in any city making use of coal, with such economies as is expected from these engines, it is easy to see that the power might be furnished much more cheaply by that instrumentality than by a distribution from waterfalls carried over a wire for some distance.

A word about the apparatus for the production of producer gas from coal may be interesting. The apparatus is very simple in its construction. In turning coal into producer gas the least number of heat units are lost, so that the resulting gas contains 90 per cent. of all of the heat units of the coal. While this gas has been used with great success in metallurgical operations, it is not one that can be distributed for heat or light, so that in the development of power the gas producer apparatus must be located in close proximity to the gas engine. Thus the gas is easily converted into electric force. Since the alternating currents of 10,000 volts can be easily delivered and used, and by means of Tesla's multiphase actors be handled for the transmission of great power, it follows that sites can be selected for establishing the generating plants where coal can be conveniently delivered. For instance, the flats adjacent to Jersey City. Mr. Westinghouse says that when an electric pressure of 10,000 volts is used, the size of the electric conductor to carry an immense power at this pressure for the comparatively short distance that will be required would be of such character that the investment for the distributing system would be relatively moderate, except on long lines of railway where a great proportionate amount of aluminum, which is probably going to take the place of copper, will be required.

Petroleum Furnace for Melting Solder.

An American invention, in the shape of a very convenient furnac for melting solder, heating soldering irons, etc., which is illustrated herewith, has found great favor in England, where it is being introduced by Messrs. Moeller & Condripp, of London. It is adapted to burn petroleum oil, the burner being of the type shown in Fig. 2. The oil in the reservoir is kept under air pressure by the occasional use of a small pump shown at the bottom of the apparatus in Fig. 1, and is forced by this pressure up a central tube to the burner. Here the stream of oil divides and passes up to the cross-piece shown in figure, which is highly heated by the flame. The oil is there gasified, and the vapor passing down to the burner forms there

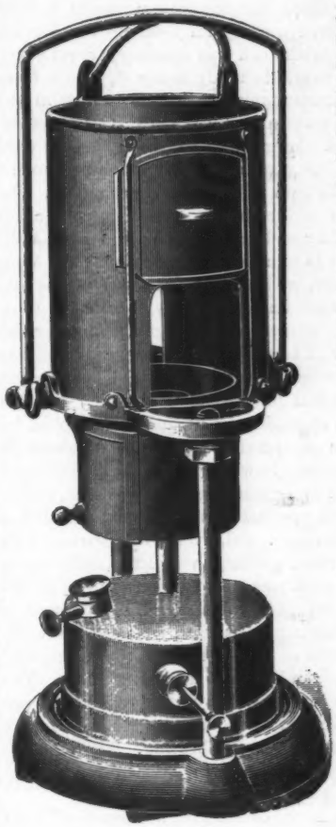

Fig. 1.

Fig. 2.

an intensely hot flame, the air supply being regulated to give the maximum of heat with the minimum of light. The flame is so hot that stout copper wire melts readily in it. The solder pot rests on a shelf immediately above the flame, whilst the side doors permit of soldering irons being heated when required. The apparatus is, it will be seen, extremely portable, and should prove very useful in many kinds of outdoor work. Blowpipes working on the same principle are also supplied by the firm in question.

Malleable Cast Iron.

By Mr. H. R. Stanford.

Malleable cast iron is made principally from charcoal pig iron, and a percentage of scrap or sprue sufficient to use the culled work, gates, runners and shrinkers that may result from the continued application of the process. After analyzing a number of kinds of pig iron, the author was led to believe that coke pig iron might just as well be used as charcoal pig, and developments have fully justified the assumption. The main difference between charcoal and coke pig iron is in the percentage of sulphur and in the cost; but if a good quality of coke is used the sulphur is not high enough in the coke iron to affect its use.

Sprue amounts to from 20 per cent. in heats for coupler or heavy work to 40 or 50 per cent. in light carriage work. An addition of 4 per cent. of heavy annealed scrap was introduced very successfully into all charges, and a large accumulation of the cheap and undesirable iron was disposed of. As much as 18 per cent. of annealed and broken couplers was tried experimentally in a charge for a coupler heat, and the resulting material was excellent, as far as quality was concerned,

but the surfaces were not smooth, and gave an impression of pock marks. As annealed scrap can be secured at $4 per ton, and as a great many will take no exception to a rough looking casting if of good quality, it seems as though there might be a use for the piles of broken couplers which a day's ride can hardly help revealing.

The furnaces used in melting maleable cast iron are cupolas and open hearth furnaces. The open hearth furnaces which the author has used are of two types, a straight forced draught furnace, using a good, hard, close, bituminous coal as a fuel, with an air pressure of 4 or 5 ounces, and a Siemens-Martin furnace, using oil as a fuel. In this furnace the fire was entirely drawn after the day's heats, and with no repairs could be used about three days. After three days the bottom needed a little fixing and the sides a little plaster, requiring an hour or two for the work. A renewal of some of the brickwork was necessary about every six months. A charge of 6 tons would be ready to tap 3½ hours from the time it was charged. The consumption of fuel depended on the number of tons per day melted, a certain amount of coal being necessary to heat the furnace for the first charge, whether 9 or 20 tons were melted. If 9 tons were melted the coal consumed amounted to 0.6 pound per pound of iron, and if 20 tons, to 0.45 pound per pound. The furnace loss was about 4 per cent. of the charge. Two men were needed to operate the furnace, the melter and the fireman; and four additional men were needed for about 15 minutes for charging each 5-ton heat. The Siemens-Martin furnace, with oil as a fuel, was of the nature of an experiment. The furnace had a capacity of about 8 tons, and was equipped with three oil burners at each end. As operated practically—that is, fired hard for 12 hours—the consumption of oil was 450 gallons in 24 hours. The checkers were used only for heating the air which was used in addition to that for atomizing the oil. Air was found far superior to steam as an atomizing agent, and was supplied by a compressor working under an accumulator pressure of about 60 pounds. At times there was considerable water in the air as delivered at the burners, and to convert that water into superheated steam, rather than to heat the atomizing air, the airblast was conducted through a hot coil just before reaching the furnace. Oil, even when burned with an excess of air, seems to decarburize the charge very little, differing in this respect very materially from producer gas. The advantage of the oil furnace was in the saving of fuel cost (which saving is, of course, a function of location of plant), in having no ashes or refuse to deal with, and in having a furnace which could be used to suit the convenience of the molders without a corresponding fuel and attendance loss. The great disadvantage—which might be overcome by additional experience—was that the checkers became clogged too soon, and too much time was required for cooling down, cleaning and reheating. The labor to operate amounted to about 25 per cent. more than was required to operate the coal furnace. The furnace loss amounted to 5 per cent.

The manipulation of the charge in the oil furnace was practically the same as in the coal furnace, and the times for melting and heating were also nearly the same. About 1½ hours was required to melt completely 6 tons, the solid masses being shifted to hurry the melting. After the charge was melted it was frequently rabbled and the surface skimmed clean of all slag after the first good rabbling. Just before tapping a second skimming was made. Two tests were made before tapping a charge, the first to see if the iron was "high enough"—that is, to see if in the heaviest form into which it was to be poured the carbon would be practically all in the combined state. The determination for a charge for ordinary heavy castings was made by dipping out a little of the iron and pouring a bar about 4 inches long and 1 inch in diameter, and after it had set carefully cooling it in water. If cooled too rapidly, the shrinkage was such that nothing could be told by the fracture, but if properly handled, in 4 minutes from the time of dipping out the iron the bar could be cast, cooled and broken. If the iron was "high enough" the fracture would be entirely white, but if not there would be little spots of graphite about the size of the head of a small pin, and more or less numerous, depending upon whether the iron needed much more or little more time in the furnace. The second test was for fluidity and was made entirely by eye, using blue spectacles for protection. If thin enough the iron was a clear white, but if not it had a kind of dark hue not easily described. If the charge was intended for car couplers or other very heavy work the test bar would be larger, or about 1½ ins. in diameter. To secure thorough mixing in the furnace and to heat the hand ladles of the molders, the first ladleful drawn by each molder was returned to the furnace through a side trough, but notwithstanding the precaution the mixture was very imperfect.

The cupola was used very advantageously in connection with the open hearth furnace. It was used for the lightest patterns and for patterns where a uniformly superior metal was not of vital importance, and for shapes in which a considerable shrinkage would not destroy all strength. The lightest patterns were placed under the cupola because the fluidity of the cupola metal was greater than that of the furnace metal, due to the higher percentage of carbon which resulted from the contact of the iron with the coke fuel. Ordinarily, if the charge is properly introduced, the quality of the product is very good, but at times the iron is not mixed in going down the cupola and gray castings result. The high temperature of the iron and the excessive hardness which was necessary to avoid gray iron in the heavier shapes made the shrinkage of cupola iron destructive to some forms, as for instance, a corner iron. In the cupola a much larger percentage of sprue could be used than in the furnace, because of the recarburizing tendency of the fuel. A high percentage of carbon in the iron is necessary for fluidity and clean castings, and on the hearth the bath loses rather than gains carbon. Coke was used for fuel, and a small quantity of oyster shells or lime served to clean the iron and keep the cupola free from slag. About ½ pound of coke was used in melting 1 pound of iron.

For small work hand ladles with a capacity of about 40 pounds were used. Hard iron, if at the proper temperature for small work, scintillates brightly when topped, differing from the more globular sputtering of gray iron.

Green sand, with a mixture of plumbago and cement for a facing, was used for molds. Most small shapes were cast with several pieces on a gate, and the pieces were so lightly attached to the runner that a slight blow was sufficient to detach them. Machines were advantageously used for making most molds.

Depending upon the form of the castings, they were next either tumbled or pickled. If the tumblers were filled properly it was surprising to see the delicate shapes that stood the treatment without breaking. The pickle was a very dilute sulphuric acid, which was poured over the castings, and after being allowed to stand for a short time was removed, together with the loosened sand, by a water bath. The hard castings were then inspected and the good ones chipped of fins and gate connections.

Carbon Brushes for Heavy Currents.

[By Mr. G. E. Hartmans, in *Electrical Review*, London.]

To those engineers who have the misfortune to be in charge of machines whose most brilliant feature lies at the toes of the brushes, the following account of experiments may present some interest.

Having first introduced one of the machines referred to as a 10-pole shunt with drum armature designed to give 500 amperes and 230 volts at 120 revolutions, with a commutator of diameter 3 feet and width 7 inches, I will proceed to enumerate the various combinations of copper and carbon which we used as brushes and the results in each case.

1. Our first excursion was made with three pairs of ordinary copper stencil brushes filed to a bevel of rather more than one section—*i. e.*, ½-inch, and it was soon apparent that something cheaper than commutator sections must be forthcoming to satisfy the sparky appetite.

2. We then decided to try the effect of a carbon tip dovetailed into a copper carrier (Fig. 1), placed in front of and touching the toe of each brush as shown, the total width of copper and carbon forming the bevel remaining the same as before. This was a decided improvement, but

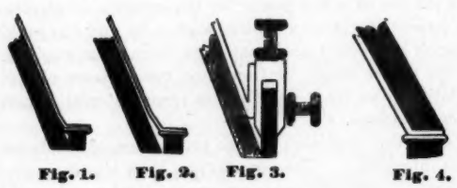

Fig. 1. Fig. 2. Fig. 3. Fig. 4.

only for a short time, as the wear of the copper brush and flexibility of the arrangement caused a gap (Fig. 2) between the copper and carbon, and the sparks returned to their former diet—to wit, the commutator. In addition the carbon tips got hot and their contact with the copper carrier deteriorated.

3. We were then at some trouble to design a suitable holder for each carbon, insuring their nice adjustment and good contact, and arrived at the ornamental result shown by Fig. 3. One or two runs with these brushes gave us some encouragement, but we were deceived in thinking our troubles were ended, for first one flat and then half-a-dozen made their appearance, and the weight of the carbon and holder, which was necessarily rather rigid, jolting over the sore places was too much

for even a copper skin. So we were obliged to return to No. 2, whilst the commutators were refreshed with an emery bob.

4. The next bait for the sparks was a set of carbons served up as shown by Fig. Fig. 4, carefully bedded and mounted in clean copper clips, the brush being placed on the top for the necessary rigidity and copper section. The total section of carbon being 3 square inches, the width slightly exceeding one section. Here, as before, the first few runs were most reassuring, the comparatively small section of carbon carrying 450 amperes in a manner far exceeding our expectations, due,

Fig. 5.

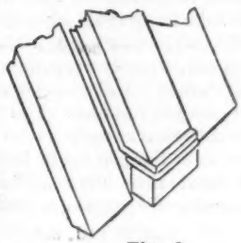

Fig. 6.

no doubt, to the cooling action in passing over such a large commutator surface. The sparking was practically nil, and the face of the commutator absolutely unmarked. On running with the full load, 500–550, the carbons required careful watching and frequent applications of vaseline, as they showed a tendency to become red hot, not all over, but suddenly in patches, and the contact between the copper and carbon became impaired as before through the continual heating. We therefore confined ourselves to a load of 450–480, using a small unit to relieve the larger ones.

5. The same arrangement, but with double the width of carbon (Fig. 5) was also tried, the result being that our position was rather safer at 500 than with the narrow carbons, and with these brushes we continued to run for more than a month, renewing the carbons occasionally as they became too much wasted. The commutators remained in perfect condition. The necessity for being prepared to overload again directed our attention to the brushes, and another effort was made in the way of a compromise (Fig. 6) between all copper and all carbon.

6. Two pairs of copper brushes, as in Fig. 1, and one pair of carbon brushes, as in Fig. 4, the latter set rather less than a section in front of the former, are now in use.

This arrangement gives far better results at loads of 500–560 than any of the previous trials. No marking of the commutator takes place under the carbons, whilst it is hardly perceptible under the copper brushes after nearly a month's running. It was found that the tension on the carbons should exceed that on the copper brushes sufficiently to enable them to take their full share of the current as nearly as possible.

I understand the last arrangement is no novelty on the continent, being in use at Hamburg and other central stations. My chief assistant, Mr. T. W. Bloxam, suggested this arrangement to me, and after giving it a trial we are able to consider our efforts quite successful.

False Economy in Foundry Equipment.

[A paper read by Mr. H. Hansen before the Western Foundrymen's Association.]

Most of you will probably say that you are as well acquainted with economy as you care to be; that your acquaintance with economy has taken the last degree of familiarity which you can tolerate; that another dose of this not altogether agreeable compound may end disastrously. Anyone acquainted with the foundry business knows that at the present time the operation of a foundry compels the injection of several grains of economy at different places in order that there may be something left on the right side of the ledger.

The term economy poorly fits too many of the savings made in the foundry. Not everything that makes a saving possible is economy; some attempts at saving might better be labeled extravagance. That the foundry industry has been prolific in examples of bad judgment and of calculations that failed to materialize is shown in the many wrecks by the wayside and in dividends that were far smaller than anticipated. The best is the cheapest, though some founders apparently act on the principle that the cheapest is the best. To such it seems economical to employ any article or tool that answers the purpose. It is said that a penny saved is a penny earned. I have seen foundries in which a penny saved was a dollar lost.

American tools and appliances are said to be the most efficient in the world. But American tools did not become so universally approved by the efforts of the village mechanic nor by every shop contriving for itself whatever labor-saving device was needed. It was only by a concentration of mechanical skill and experience that American tool builders made themselves famous for the high standard of efficiency, the general utility and the simplicity of their products.

Shops producing their own tools exclusively are becoming scarce. Homemade contrivances are giving place to machinery perfected by specialists and installed on the purely business principle that they will lower the cost of the product. Making a special study of the needs of each industry has not only furnished better tools, but decreased their cost in corresponding proportion. The machine shop that would undertake to build a lathe or boring mill for itself would find itself greatly handicapped in the matter of cost, when compared with one of the regular tool works. But even leaving the question of first cost aside, how would the home product compare with that of a firm making a business of building such tools? Would it give the same degree of efficiency with the same expenditure of power?

Power costs money, whether the prime mover be a foreign laborer at a dollar a day, or steam, air or electricity. Any tool that requires a greater amount of power than others of the same class and efficiency, is not economical. Yet how many foundries disregard this altogether and purchase tools that are sometimes called regular steam eaters, because they are cheap, and then pay the difference many times over in extra cost of operation.

The manufacture of foundry tools is becoming a trade of itself, and the men engaged in it are bending every energy toward developing superior appliances for the foundry. The ordinary chaplets, for which almost every foundry used to rely on the blacksmith nearest at hand, and which have probably been the cause of more castings being discarded and patched up than any other thing of their size, are being made by special methods and presented in a far superior condition, besides being placed on the market at a price which would not keep a blacksmith in tobacco. At the same time there are many foundries that still insist on making their own inferior chaplets. Are they practicing economy?

Not long ago I was employed by a firm who concluded to make a grinder themselves rather than purchase one. They had the draftsmen, pattern makers, machinists and molders, with plenty of wood and pig iron in the background, so it entered their mind that there could not be much expense attached to converting this into whatever they saw fit. Owing to the ignorance of their foundry foreman, who was not accustomed to this class of work, the main casting or bed was cast three times before producing a passable piece of work. The smaller parts went the same way, and there was hardly a piece connected with it that was made on the first trial. In nearly every case success only came after some experience had been paid for. When it came to assembling, I have an indistinct recollection of several pieces refusing to be put together. Parts which should have been cast separately were consolidated to make it easier for the pattern maker and machinist, with the result that lugs and projections protruded in such a manner as to resist all attempts at bringing them together. When I last saw these relics of an ill-fated enterprise they were covered with dust, and although times were dull and several shut-downs became necessary, this firm who were going to make this machine so cheap never said a word about finishing it up and getting it ready to work.

The proprietors of the neighboring foundry about the same time found themselves in want of a crane to replace an old rattletrap that threatened to fall down and carry with it more destruction than it was worth. Inquiring of several dealers in foundry equipments, they were surprised to learn that a crane would cost more than the charge for freightage. But they found a way to overcome this difficulty. They had a machine shop and foundry; they had all kinds of materials that are supposed to enter into the composition of a crane; they had men, too, who knew how to use up such material, so why should they not make the crane at home and get just what they wanted? But the making of cranes was not their business, so a well-paid employee was intrusted with the gathering of information on this subject. After a month spent in visiting places where cranes were in use, measuring their dimensions, finding out the ratio of their gearing, the size of chain used, etc., they were ready to make what patterns were necessary, and borrow and make answer whatever short shifts they could make up.

Perhaps you think they didn't make that crane work; but they did. And I understand the intention was to cast a fancy name plate to adorn it, but this motion was reconsidered when they discovered the amount of power they had to furnish this creation of theirs before it would

budge. Power is money, and if this foundry practiced economy in building a crane, say 25 per cent. less than they could purchase one for, when it required 75 per cent. more power to operate it, I want you to tell me where it is?

It takes a man with good abilities to become a good imitator, as it does to be a fair originator. In fact, it takes a very smart man and mechanic to execute a first-class job of imitation. It seems the easiest thing in the world to take a machine to pieces, secure its measurements and turn out duplicates. Yet how many of such imitations have the efficiency of the original when assembled and put through the real test of actual work?

As amateur tool builders most of our foundries do not achieve success. They may for a while be deceived by the external appearance of things, yet we all know how soon a dollar's worth of extra labor can be consumed on a crane or other tool without exciting suspicion. Such leaks are common and increase the cost of every pound of castings made, but it is seldom that a determined effort is made to locate them. There might be some unsavory disclosures that would endanger the position of many a designer attempting to administer to the wants of people with whose requirements he was entirely unfamiliar.

The admiration we show for the work accomplished by a tool is doubly increased if it only requires a minimum of power in its operation. Although none of us entertain the idea that work can be perfomed without the consumption of power, yet we have a high regard for those tools that get along with the least. We all recognize the advantage these have over others that call for a larger expenditure.

It is a false economy that suggests to many of our foundrymen today that labor-saving tools can be made at home and reach the same degree of perfection attained by builders who devote their whole time to tool building exclusively. Without reserve not one foundry in ten can produce a creditable tool, simply because such an attempt involves entering strange fields where experience must largely be paid for in failures.

Discussion.

W. Ferguson—I agree with Mr. Hansen's paper in the main, but there are always exceptions. I believe that there are instances where shops can avail themselves of their own opportunities by building tools and equipment without going outside altogether. My friend here on the right just told me of an instance in their works where they had some cranes to overhaul and they got bids on them. The estimate of outsiders was about $6,000 for changing the cranes from rope to electric power, and they themselves went to work at it and it cost them $2,100. He told me that they got as efficient a tool in the end as they could have obtained through outside contractors.

The President—Mr. Ferguson, what is the most evident case of false economy in the foundry that occurs to you now, in your experience? I don't think this paper treats the subject quite as broadly as it might. It seems to be confined more to the question as to whether it is advisable for foundries to make their own machinery.

Mr. Ferguson—I see so much of it I would not know where to start on that point. Cases occur every day in foundry practice that would be called false economy by one man from observation. If he were made fully aware of all the conditions in connection with it he might finally approve of it as true economy. We are forced, especially in a jobbing shop where new jobs are coming in every day, to make shift to get that job out, while we know that it is a shiftless kind of rigging. We never expect to see the job again, and to an observer it would seem as though it was practicing false economy to make that job in that way, but to those knowing the conditions it is clear that it is the greatest economy.

E. E. Hanna—One cause of false economy is to employ cheap men; another is cheap iron—cheap to get out of the foundry, expensive in the machine shop. Cheap men make poor castings and have to make them over again. Cheap material is dear all the way through. Economy in any line of business is simply a question of careful consideration of all the points. It may be that, as Mr. Ferguson says, a makeshift would cost less both in time and labor for a job that is to be made but once than it would to make a good, substantial tool to do the work, a tool that if you had hundreds or even ten of a piece to make it would make for itself many times over. Yet for one piece, the cheaper tool, the makeshift, is the better. It is simply a question of actual computation as to what the job is going to cost finished. Now, the economy point comes in a man's being able to sit down and carefully consider all the points involved in the question. It means that if a man will take up the first way of doing a job, blunder ahead and do it in that way—that would be false economy. To sit down and carefully think over the job, figure out all the ways and possibilities and take the cheapest under the circumstances—that is the true economy. Mr. Hansen's paper treats of the matter in a general way. It says nothing about any particulars, and particulars would last us all this meeting. There is no doubt whatever but there must be something wrong with people who are in the business of making tools if they are not better equipped and better posted to make better tools than a man that is in general work. It simply means that if you can make your tools cheaper than the people in that business you are either extraordinarily smart or else the people in the tool business are somewhat behind the times.

The President—I think one point in the question of economy is very likely to arise in the manner that Mr. Hansen has described—that is, liability to take for granted when only one casting is to be made, for instance, that an inferior rig or method to make it will answer, because there is but one, without stopping to calculate the chances of the loss of that one casting. And what becomes of the question of economy or expense in case you lost one? You would have to, in the end, make a better arrangement or make two or three to get it. Of course, those things have to be thought out by individual cases and all the facts that have been stated taken into consideration, and if this paper leads any of us to meeting the matter in that way, I think it will do us some good.

John Pettigrew—One thing that struck me in our friend's remark was that there are a great many things to be taken into consideration—for instance, the matter of fuel. I remember some years ago while working in a foundry that a party offered to sell some coke to the proprietor for 25 cents a ton less than he was paying at the time. He bought a carload of the coke and commenced to use it, making agricultural machinery. The consequence was the master wheels were all oval instead of round, and the other work that used to be good was sprung and broken. They could not tell for several weeks what caused the trouble, so at last it was decided to change the coke and go back to the old material that had been used before and then everything went swimmingly. I think economy like that is a very false economy. There are other points that Mr. Hansen touches upon in his paper that I think economy can be used in—making tools for the shop, for instance. I know a party who not very long ago needed a crane; he got bids for the sort of work he needed, which amounted to something like $400. It was more than he could afford at the time and he decided to make it for himself. He counted up the actual cost and it was $62. I think that it would do perfectly well. It is only about six months ago that I first bought made chaplets. We were making our own chaplets and we lost a great many castings from their not being properly made. After we had bought the first lot, for, I think, 60 cents per 100 chaplets, I commenced to figure up the cost of the chaplets we had been making and found it had been $2.50, besides not having such a good article.

W. N. Moore—The general thought in Mr. Hansen's paper I heartily agree with. There are a great many points in connection with the economical operation of a foundry which are not even mentioned. There is one which occurs to me which may be apropos at the present time if the present improvement in business continues, as we all hope it will. That is, where is the point in capacity at which a foundry can be operated with the greatest net profit? I think the capacity of the foundry for economical operation is frequently overrated. It is my belief that many of us are carrying the idea too far that increased volume of business reduces expenses. I believe that if some of the periods in which work was most plentiful and our foundries were operated to their fullest extent were analyzed, although those periods are probably periods of greatest profit, it would be found that the profit was not made on the very last part, the extreme end of the volume. When a foundry is operated to the point where efficient help cannot be brought to bear upon the various operations, when you must break in new men, it is our observation that the percentage of bad work increases, that there are all sorts of expenses. Some part of the machinery is overtaxed; there are breakdowns and night work and Sunday work, and there is a tendency to looseness in management that must be paid for. We go through a period of great strength with the idea that by pushing everything to the utmost we are making the most money out of it. Now, undoubtedly the business will give more profit by being operated fully than it will if it is being half operated, if the organization is complete. But what I want to call attention to is whether there is any real profit in overcrowding our foundries. I believe there is danger, and the records of the establishments with which I am connected rather go to prove that—that is, they are disappointing. Our periods of greatest activity, when we have been overcrowded and have turned out the largest volume of business, have not made returns in profits that they theoretically should, taking the periods of slowness as a basis, and considering that our fixed expenses are spread over a much larger volume of business. That, it seems to me, is a question which is

likely to arise with a great many in the coming year; perhaps it is already upon us. I know a great many foundries are not full up to the brim. It is a question whether it is best to produce with the greatest economy or to make extra effort and do the things which are necessary in emergencies and incur extra expenses. We certainly do not get the contentment out of the business that we do when we are working along with an even load.

E. E. Hanna—Following up Mr. Moore's idea, did anybody ever make anything by working nights and overtime? Sunday is worse than nights. I don't believe anybody ever made anything by pushing his plant beyond its capacity at all, but it certainly should be pushed just to its capacity to give us the best returns for the energy and the money invested. I believe that the larger the equipment, if properly handled, the cheaper we should do our work. The pushing beyond capacity applies in every case, small or large. I believe in buying a good tool and wearing it out just as quick as I can without abusing it; get all the work you can out of it, and get it out quick. That is, if you spend $1,000, say, on a tool, and you get that $1,000 worth of work out of the tool in one year, instead of keeping it to work for 10 years, you get about nine times the profit from the machinery that you would to run it for 10 years. That is, you get nine times the interest on the money invested. For that reason every tool should be pushed just to the limit of its endurance in legitimate work. Now, Mr. Pettigrew brought up another subject, the question of poor coke. What should the tonnage of a foundry be where they can afford to know what they are buying; where they can afford to keep a chemist, and know exactly what they are buying, what they have got to use, and what they have got to get? There is a nut to crack.

John A. Penton—Following up the idea strictly that is brought up by Mr. Hansen's paper, I want to say that in my opinion the most flagrant and perhaps the most universal example of false economy in the foundries in America is the false economy that is used in trying to secure a foundry foreman a little cheaper than necessity requires. If by securing a first-class foundry foreman we do pay a little more, we perhaps make it up in many other ways. That is a sample of false economy that I believe is not universal, but more nearly so than any other one. If a first-class foundry foreman were secured who understood his business thoroughly, he would watch for little leaks—the matter of buying an inferior grade of iron, inferior coke, making suitable rigging to get out a particular job, the matter of seeing that the proper time is put in, the matter of seeing that a first-class mechanic is secured at a reasonable rate of wages, rather than in trying to save 15 or 20 cents a day and making it up by losing a $10 or $15 casting.

James A. Brady—A great deal of false economy is practiced in the office of the foundry. It is not with the practical molder or the practical foreman. I have been connected with foundries where they did all their buying in the office. Perhaps some young man gets into the office and he is put in the position of buyer. Somebody comes along with iron that is 50 cents a ton cheaper. He will buy it and ring it in on the foreman. Perhaps he will try to pass it off as another brand, as another iron. The same is true with coke. I have had in my experience times when they would give me very inferior iron and coke and try to pass it off on me and argue the matter with me, when I knew and they knew that it wasn't the fact. They were giving me those cheap things and expected the same results.

Electric Pumps for Water Works.

At the last meeting of the American Water Works Association, Mr. John M. Godell read a paper on the subject named in the heading, in the course of which he said:

One of the earliest electric pumping plants in this country was built at San Antonio, Tex., for the local water company, to supplement two plants operated by water power, and located some 3 miles from the business center of the city. The electric plant was placed in the heart of the city, within a few feet of a 45-foot standpipe supplied by four 8-inch artesian wells. Three Goulds triplex pumps were installed, each having three outside packed plungers of 10 inches diameter and 12 inches stroke, the whole plant having a capacity of 2,250,000 gallons in 24 hours. Each pump was provided with a separate suction pipe and valve, and discharged through a separate pipe and check valve into the force main running to the city distributing system, thus enabling the amount of pumpage to be adjusted fairly close to the demand. Each pump was connected directly to a 30-horse power C. & C. motor, taking a current of 500 volts from the lines of the local electric light company.

Several features of this plant deserve attention, as indicating some of the advantages of such works. It will be noticed that the old pumping plants were operated largely by hydraulic power, some 3 miles from the city, while the new plant is located in the town. This means the elimination of a friction head of 20 feet at least, and probably much more. Another thing to be noted is that there was no boiler plant at the new station. Whenever the pressure fell in the water pipes it was only necessary to turn one, two or three switches to throw as many electric pumps into service, and by opening the switches again the pumps were stopped. The electricity was not running to waste while the pumps were idle, and there was no banking of fires under boilers. All this means that not so much attendance was required.

One of the latest plants of this sort is that at De Kalb, Ills., which has two 10x12 inch Goulds triplex pumps, driven by two direct connected general electric motors. This plant was recently tested by Daniel W. Mead, and some figures from his report are appended, as indicating the general efficiency of the station, although it should be stated that the apparatus was new, and consequently stiff, and that the electromotive force was not kept up during the tests, facts which naturally tend to lower the records materially. A test of one of the motors, which was furnished with a current of 200 to 220 volts, showed that its efficiency ranged from 83 per cent. while delivering 20-horse power to the pump to 92 per cent. while delivering 55 horse power. The tests of one of the pumps and its motor gave the following results:

Duration, minutes	14.00	28.00	12.00	44.00	60.00
Amperes	156.00	215.70	206.05	243.30	111.00
Volts	193.40	192.00	195.00	186.80	203.00
Horse power furnished	40.44	55.54	55.54	60.93	30.20
Total lift	88.50	130.00	129.50	133.50	62.00
Revolutions per minute	41.75	42.50	41.71	45.90	44.80
Combined efficiency of motor and pump	64.90	71.00	72.00	71.90	65.60
Pump efficiency	70.50	75.40	78.10	75.20	75.20

The slip of the pumps was calculated from indicator cards, and seemed to be 12 per cent. for the suction valves and 0.9 per cent. for the discharge valves.

This station, like that at San Antonio, is instanced here as showing the utility of electric pumping machinery in places where current can be obtained from local electric plants. Such a pumping station occupies comparatively little room, requires the services of but one engineer on a shift, has no boilers to be fired, and can be put in instant service at any time by turning the proper switches. Its greatest drawback is the possibility of a sudden stop in the current supplied from the generating station, and the importance to be attached to this possibility depends largely on the character of the station and of the men in charge of it.

Such works are not, however, the most promising field for electric pumping systems. Their advantages are most apparent when it is necessary to build works for a small place without water in the immediate vicinity. In such a locality the pumping station may be required several miles from the town and from a railway. If it were a steam plant the annual cost of fuel delivered over rough roads to the station may be a serious matter. In such a place electricity offers an easy solution of the problem. As an example of what it will do the plant at Canandaigua, N. Y., may be cited. This is still in course of construction, and it is, therefore, hardly proper to more than outline its features here. The power station is conveniently located in the village, while the pump house is at Canandaigua Lake, 3½ miles distant. Two of Gould's 12x12 inch triplex pumps are driven by a direct connected 100-horse power general electric motor. The three-phase system of transmission is to be used, and the current is to be furnished by a 100 K.W. generator at the power station in the town. This generator is to be driven by an engine of 115 horse power, nominal.

It is for such a plant as this that electricity seems particularly suited. The advantage of putting a power house near a railway, so that coal can be secured at a low rate, is an important matter, and if an electric light plant is to be installed at the same time as the water works the use of power pumps is all the more likely to be profitable. The demand for water varies inversely through the 24 hours to that for artificial light, and this makes the design and economical management of such a combined plant so much the easier. The writer does not mean to say that such a station will be suited to the local conditions of every town wanting water and electric light, but he does believe that a town will make a mistake in adopting independent plants for such purposes, without securing estimates of the cost of building and running a combined station.

Another promising field for electric pumping is furnished by small high service districts which have to be supplied by special pumping apparatus of small capacity. Still another use to which they may be put

in some cities, covering a large, flat area, and supplied with water from one or two main sources, is to serve as relay pumps, similar to the relays used on oil pipe lines. These are located at a considerable distance from the main pumps, at places where the friction head in the pipes has reduced the pressure materially, and raise this pressure by taking water from the main pipes and forcing it along through them under a greater head. In this way the pressure on the pipes before and behind the relay station is increased.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

At the annual meeting of the Amesbury (Mass.) Gas Company the following officers were chosen: Directors, Messrs. L. C. Wadleigh, W. E. Biddle, T. H. Burnham, G. E. Gale and E. R. Sibley; President, W. E. Biddle; Secretary and Treasurer, G. E. Gale.

We regret to announce the death of Mr. James T. Duff, Chief Engineer to the Consolidated Gas Company, of Pittsburgh, who succumbed to an attack of pneumonia on the morning of October 3d. Deceased, who was in his 74th year, served the Consolidated Company with zeal and success for upwards of 20 years. The funeral services were held at his late residence, Atlantic avenue, Pittsburgh, on the evening of October 4th, the Rev. George W. Izer, of Christ Methodist Church, officiating. Interment was made in Philadelphia on the 5th inst.

Proprietor Forney and Business Manager French announce, in the current number of the *American Engineer and Railroad Journal*, that, from November 1st, that publication will be issued bi-weekly, appearing every alternate Thursday. Editor Forney announces that improvements in the scope and character of the paper will be made; and Manager French conveys the information that the subscription rates in the United States, Mexico and Canada will be $2.50 per annum, instead of the former rate of $3. We congratulate our contemporary on this evidence of its vitality, and are sure that the enterprise thus shown will be appreciated by the workers in the field of which it has been such an intelligent and persistent cultivator.

The Berlin Iron Bridge Company, of East Berlin, Conn., has just completed, for the town of Hadley, N. Y., a bridge 300 feet long and 16 feet wide. The same Company has recently finished a new storeroom for the Hartford (Conn.) Rubber Works, a new car house for the Norway Tramway Company, South Norwalk, Conn., and a new generator house for the Burlington (Vt.) Gas Light Company. The Berlin Company reports work as very brisk in all departments.

The Buffalo (N. Y.) *News* says: "John F. Moffett, a stockholder in the Medina (N. Y.) Gas and Electric Light Company, made application to Judge Spring, in the Supreme Court [September 27th] for the appointment of a receiver for the corporation. He alleges that A. L. Fennessy, President of the corporation, was trying to wreck the Company. Mr. Fennessy's lawyers denied the charge in the strongest terms and said Mr. Fennessy was trying to build the Company up instead of wrecking it. Judge Spring referred the matter to Arthur W. Hickman to take proof."

A correspondent at Nashville, Tenn., forwards the following under date of October 3d: "At a special meeting of the City Council, of Memphis, Tenn., held on the evening of September 30th, the following ordinance was presented by Mr. Jno. T. Walsh:

"'Be it ordained by the Legislative Council of the city of Memphis:

"'Sec. 1. That all gas companies within said city furnishing light to it and its inhabitants, by means of pipes or other conductors laid in or under the streets or sidewalks of said city, shall be and are hereby required to furnish gas of not less than 16-candle power, and that the same shall be as free from deleterious and harmful elements as practicable.

"'Sec. 2. That the rate to be charged for gas so furnished, either to said city or to the inhabitants thereof, shall not exceed the sum or price of $1.50 per 1,000 cubic feet, when paid within the customary discount days, with the right on the part of said Company to add 5 per cent. thereto if not so paid.

"'Sec. 3. That the office of gas inspector is hereby created, to be filled by the Legislative Council on the nomination of the Mayor, at the next regular monthly meeting after the final passage of this ordinance. He shall hold office for a term of one year, and shall give bond in the sum of $—— for the faithful performance of his duties.

"'His compensation shall be fixed by the Fire and Police Commissioners, and paid out of the lighting fund.

"'It shall be the duty of such inspector to see that the gas furnished is of the quality and illuminating power above prescribed, that the gas meters furnished properly measure the gas passing through them, and, generally, such other services as may from time to time be imposed upon him. Some question was raised by Councilman Haszinger as to whether or not the city could, by passing the ordinance, annul the contract with the Equitable Gas Company, which allows the charging of $1.75 by that Company, but an examination of the contract, which declared that the Company could charge 'not to exceed $1.75,' disposed of the objection, and the ordinance was passed on its first and second readings, the rules being suspended to pass it through second reading. The mode of remunerating the gas inspector was not determined, the Council being undecided as to whether to give him a salary or to let him collect fees for inspecting meters from the citizens, if the meters are correct, or from the gas companies, if the meters are found incorrect."

The Finance Committee of Philadelphia Councils has allowed the appropriation of $500,000 asked for by the Department of Public Works. Of the amount allotted $190,000 is set aside for the construction of a new holder at the Point Breeze station of the city gas works.

The newly incorporated Hammond (Ind.) Gas Light and Power Company, of which concern Mr. J. S. Ward is Manager, seems to be in for actual business. At any rate, Mr. Ward says so, and he also announces that a site for the works has been secured on the south bank of the Calumet river, between Hohman street and the Columbia Spring Works.

Mr. Isaac B. Clark has accepted a position with the Waterbury (Conn.) Gas Light Company.

The special election ordered at Excelsior Springs, Mo., for the purpose of determining whether or not the streets should be lighted by gas lamps resulted in an emphatic indorsement in favor of the plan.

The Indiana State Gas Inspector, Mr. J. C. Leach, is endeavoring to suppress the use by the farmers in the natural gas districts of the wasteful flambeaux lights or torches.

Mr. John M. Latimer, of the Jefferson City Gas Light Company, New Orleans, La., is dead, at the age of 52 years.

The following is the agreement and plan of reorganization proposed for the legal unification of the gas interests of Chicago. The contracting parties are Messrs. F. P. Olcott, Roswell P. Flower, A. N. Brady, Walton Ferguson, C. K. G. Billings and W. J. Campbell, of the first part, and the respective holders of the certificates of the Fidelity Insurance, Trust and Safe Deposit Company, of Philadelphia—issued upon the surrender of certificates of the Chicago Gas Company—who have assented to and who shall hereafter assent to this agreement by depositing their certificates as hereinafter provided, of the second part. The agreement avers:

1. The parties of the first part are constituted a committee to exercise the powers set forth.

2. The committee shall invite the holders of the Fidelity Company certificates to become parties to the agreement by depositing their certificates with the Central Trust Company, of New York. The committee shall exercise all the powers of owners of Fidelity Company certificates deposited and shall have the right to use the certificates in such manner as it may deem proper for carrying into effect the provisions of the agreement.

3. The committee shall, as soon as may be practicable and in such manner as may be advised by counsel, effect a merger of the several companies whose properties are represented by the certificates so as to constitute one corporation under the laws of the State of Illinois.

4. The committee shall have power to do any act which it may deem proper and is legal to preserve the security of the holders of the guaranteed mortgage bonds.

5. As soon as the proposed consolidation shall have been effected the committee shall have the power to deliver to the Fidelity Company the certificates which shall have been deposited and receive the certificates of said consolidated corporation, which new certificates shall file the registered owners to the same proportional interest in the consolidated corporation as was represented by the Fidelity Company certificates.

6. In the event that during the existence of this agreement any dividends shall be paid for the benefit of the several holders of Fidelity Company certificates the committee shall be entitled to collect all such dividends as may belong to the deposited Fidelity Company certificates

and shall distribute any sum received among the holders of the Central Trust Company receipts.

7. The committee is vested with all power to do any acts necessary and proper in its judgment to be done to carry out this plan, including the power to make such changes in the same as it may deem expedient or necessary, provided that no change shall be made which shall involve the acceptance by any receipt holder of a less proportional share in the consolidated corporation than his present proportional share in the deposited stocks. If necessary in its judgment it may provide funds for the purpose of carrying this agreement into effect by means of loans for such times and at such rates of interest as it may deem proper, and pledge as security therefor all or any part of the certificates deposited hereunder, but shall not have the power to bind any holder of any Central Trust Company receipt issued hereunder for the payment of any assessment, or, personally, the payment of any money.

8. It is expressly understood that the committee assumes no responsibility for the execution of the above plan. The members, however, undertake in good faith to execute the same. They shall not be personally liable in any case for the acts of each other nor for their own, except in case of willful malfeasance or gross negligence, nor shall they be personally liable for the acts of their agents or employees. The members of the committee may be or become pecuniarly interested in any of the property or matters which are the subject of this agreement, and they shall be allowed their expenses for counsel fees and otherwise and a reasonable compensation for their services.

9. Any member may at any time resign by giving notice in writing to the other members.

10. If any of the provisions of this agreement cannot be strictly performed by the committee, then it shall conform as near as may be to such provisions.

11. The committee shall, within one year after the organization of the consolidated company shall have been completed and said consolidated company shall have taken possession of its property, file its accounts with the Board of Directors of the consolidated company, and the same shall be final, binding and conclusive upon all of the parties to this agreement.

ELSEWHERE we note briefly the death of Mr. James T. Duff, Chief Engineer to the Consolidated Gas Company, of Pittsburgh, Pa., and to that mention we add the following, forwarded by a correspondent: "Mr. James T. Duff, Chief Engineer of the Consolidated Gas Company, of Pittsburgh, died at his residence, on Atlantic avenue, near Penn, at 1 A.M., of the 3d inst. Mr. Duff was in the 74th year of his age, and was attacked with pneumonia about three months ago. He was enabled to attend to his duties at the works until a few days ago, when his condition became serious. Few men in the business stood higher than the deceased, and his knowledge of all the details was considered authoritative. He was born in Philadelphia, and received his early education in that city. Nearly 50 years ago he became connected with the gas business, and previous to his coming to Pittsburgh he had experience in the industry in the gas plants at New Bedford, Mass., South Bend, Ind., and Memphis, Tenn. He had been Chief Engineer of the Consolidated Gas Company for 20 years. Mr. Duff was unassuming in his manners, and was held in high esteem by the officers of his Company and his subordinates at the works. He is survived by his wife, who is a sister of John Fields, ex-Postmaster of Philadelphia and President of the Mechanics National Bank of that city. Mr. Duff had many relatives here. Robert Downing, the Controller of the Pennsylvania Railroad, is his step-brother, and other relatives are John S. Scully, Cashier of the Diamond National Bank, and George K. Stevenson. The funeral services were held at the residence, on the evening of the 4th inst., the Reverend George W. Izer, of Christ Methodist Church, officiating. The remains were taken to Philadelphia for interment."

THE Newton and Watertown (Mass.) Gas and Electric Lighting Company has completed substantial brick buildings on Watertown street, intended for stable, carriage house and workshop. The ground dimension is 100 by 40 feet, and the height is 20 feet, divided in two stories. The cost of the buildings was about $8,000.

THE Spring City Gas Works, of Royersford, Pa., sustained damage last week, amounting to perhaps $100, because of an accidental ignition of naphtha vapor. But for prompt and well directed action the fire might easily have been a serious one.

THE Buffalo (N. Y.) *Courier* says that the Standard Gas (natural) Company, of Tonawanda, N.Y., has given notice that hereafter a charge of 5 cents per 1,000 cubic feet will be made on account of rental of meters. Capt. H. M. Fales, Secretary of the Company, explains this action by saying that the Company was really forced to make the additional charge, as the income derived by it from the sale of gas was not sufficient to pay its running expenses.

TOWARDS the close of September, at a meeting of the Canton (Ohio) Council, the matter of fixing the gas rate was brought up by Mr. McQuern, who moved to reconsider the action taken at the previous meeting in the same premises. Mr. McQuern suggested that the rate per 1,000 be put at $1.20, with 20 cents discount when bills were paid in 10 days from time of presentation, that schedule to last for a period of five years. Mr. Weirick wanted the rate fixed at $1, without conditions, and Mr. Sexauer thought the period of the agreement should not exceed three years, both of which suggestions were negatived, and the McQuern plan was adopted, Messrs. Sexauer and Weirick voting in the negative.

WE are in receipt of the season's catalogue, issued by Messrs. George M. Clark & Company, which details in clever manner the merits of the gas radiators and heating stoves now being offered to the gas industry by that well-known Chicago house. The catalogue is unimpeachable in style and arrangement, and the illustrations, typography and press-work are simply excellent.

THE reduced gas rate at Northampton, Mass., went into effect on the 1st inst. The net price now is $1.60.

THE Minneapolis (Minn.) Gas Inspector (Mr. A. D. Meads) reports that the average candle power of the gas supplied during the month of September by the Minneapolis Gas Company was 24.01. Seven meters were tested on the complaint of consumers. Of these six were found to be within the legal limits, and the seventh was found to 4.8 per cent. slow.

THE local offices of the Huntington (L. I.) Gas Company have been removed to the Pearsall Building, Huntington.

PAPERS incorporating the United Wood Gas Company have been filed. Its purposes, as stated, are "the manufacture, purchase and sale of gas, also the machinery and appliances necessary thereto." East Orange, N. J., is the principal place of business, but the Company is also to have a headquarters in this city. The capital stock is put at $30,000, and the incorporators are Messrs. Wm. L. Quintard, Geo. S. Dearborn and Chas. L. Gately, of New York; Francis J. Post, of Massachusetts, and Wm. S. Douglas, of New Jersey.

THE Leadville (Col.) Gas Company has brought suit against the local authorities alleging illegal abrogation of contract. Some years ago the authorities contracted with the Gas Company to perform the street lighting by means of gas for a period of 20 years, for a stipulated sum per lamp per annum, and quite a while before the contract would expire the authorities determined to go into arc lighting. They ordered the Gas Company to discontinue the gas service and the Company refused, continuing the same, and rendering a bill therefor, which the authorities refused to pay. Hence the suit.

ON October 3d, Mr. Arthur G. Bishop, of Flint, Mich., began suit against the Port Huron (Mich.) Fuel Gas and Light Company, asking that he be appointed receiver for that enterprise, on the ground that the Company has been managed with extravagance and waste. Mr. Bishop holds a mortgage for $15,000 on the property. This is the concern which was organized with the main purpose (nominally) of supplying fuel gas at 50 cents per 1,000 cubic feet, and illuminating gas at $1, under the Archer process; but no doubt the ultimate hope was that the old Port Huron Gas Light Company would eventually be driven to the wall. The latter, however, is not in any sense in need of the fostering care of a receiver.

THE new franchise for the Muskegon (Mich.) Gas Light Company declares that the corporate life of the Company is to be for 30 years, and that the gas it sells shall be supplied under these terms: 5,000 cubic feet and over per month, $1.60 per 1,000; 1,000 to 5,000 cubic feet per month, $1.80; but $2 per 1,000 may be charged when the monthly bill shows a consumption of less than 1,000 cubic feet. When gas is furnished for heating, cooking and illuminating use, the rate may not exceed $1.20 per 1,000. Payment of bills on or before the 15th of the month entitles the consumer to a rebate of 20 cents per 1,000. It is also stipulated that the quality of the gas supplied shall be of the standard of that sent out by the Detroit Gas Company. Another stipulation is "that whenever five responsible applicants in five different buildings agree to take gas from the Company, for at least six months, then the Company shall extend its mains up to 250 feet, and furnish the service desired."

THE AMERICAN GAS LIGHT JOURNAL

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MONDAY, OCTOBER 14, 1895.

Commercial Products from Acetylene.

Mr. R. K. Duncan, in some speculations on the possibilities of acetylene in commerce, says:

It occasionally happens that the easy synthesis of one chemical compound will unlock the door to the cheap commercial production of a room full of others. It is declared that calcium carbide (with water power to run the dynamos) may be made for less than $20 per ton. Now, from 1 ton of calcium carbide we may obtain 812 pounds of acetylene gas, costing less than 2½ cents per pound. This means, with certainty, the cheaper manufacture of innumerable substances used in the arts which may be made from acetylene by processes which, up to this time, have been matters of pure chemistry, but which, on account of the lessened cost of acetylene, will now wage war with the older methods.

Acetylene, on being passed through an iron tube heated to dull redness, goes rapidly and completely into benzine, without the formation of any other product. Benzine is a product of prime importance, and is the base of thousands of organic substances, known as the benzine series of compounds. If the resulting benzine vapor be passed into strong nitric acid it is transformed into the oily nitro-benzine, and this, on treatment with hydrochloric acid and iron filings, goes easily into aniline. The ton of calcium carbide, or the 812 pounds of acetylene, results thus in somewhat less than 956 pounds of aniline. With the formation of aniline the road is now clear for the production of the innumerable dye substances whose varied hues have adorned the sisters and wives of the last 20 years, and whose discovery and preparation absorb the energies of an army of chemists.

Instead of passing into the dye substances, however, we may transform our aniline into carbolic acid. Thence it is but a step to picric acid, the foundation substance of many modern explosives. Or, again, we may boil the aniline with acetic acid, and we have transformed it into acetanilide or anti-fibrin, the well known fever specific.

Our protean acetylene, however, is capable of undergoing other changes just as startling. For instance, if it be passed through a tube heated to bright redness, it is changed to naphthaline, and naphthaline again will pass into a multitude of other valuable products. Or again, starting with acetylene, by the action of nascent hydrogen, we may change it into ethylene and finally into ethane. Ethylene, on being boiled with sulphuric acid and water successively, passes into alcohol, which is absolutely necessary to the production of an enormous number of economic substances. Ethylene, on treatment with permanganate of potash, readily oxidizes, first into oxalic acid, and then into formic acid. If the formic acid so obtained be treated with ammonia, and the resulting product heated to 180° C., it is transformed into the deadly prussic acid. Acetylene in the mere presence of salts of mercury unites readily with the elements of water to form aldehyde, so much used to-day in the production of essences and the manufacture of mirrors.

Starting with acetylene, by the agency of such cheap commercial products as muriatic acid, sulphuric acid, potash, ammonia and a few others, it is possible to build up whole systems of dyes, medicines, essences, perfumes, poisons and explosives. The methods by which this may be accomplished are known matters of pure chemistry. They become commercially and economically practicable with the cheap synthesis of acetylene. Since this has been accomplished by the aid of the electric furnace and a mixture of lime and coal, we may expect to see the influence of acetylene ramifying throughout all organic chemistry. It has a utility out of all proportion greater than that derived from its peculiar light-giving powers.

An Electrical Heating Plant.

The *Iron Age* says no little interest will be taken in a heating plant which is being installed in the Carmelite Monastery at Niagara Falls, Ont., inasmuch as electricity will be used for the purpose. It is not intended that the entire institution shall be heated by electricity; but as a fixed amount of electric power has been arranged for by the institution the surplus will be used for heating a portion of their building. Electricity will be used entirely for cooking and for all power purposes, and also for laundry work. The contract for installing the system has been secured by the F. W. Oliver Company, of Niagara Falls, N. Y., and has been designed and will be installed under the supervision of W. S. Hadaway, Jr., of the Central Electric Heating Company, of 107 Liberty street, New York. The cost of heating buildings by electricity has not as yet reached figures which will make it an everyday competitor in the heating world, consequently the operation of the heating system in this monastery will be closely watched by all who are interested in the electrical field. While electricity has been used for heating street cars, it is because it presents so many advantages over any of the systems which have been in use in the past and not because it is economical.

The Market for Gas Securities.

There is not much to say in connection with the market for city gas shares, steadiness having been the prevailing feature for the week, in respect of Consolidated, which came in to-day (Friday) at 144½ to 145. The stock is undeniably a purchase, for it is quite a certainty that no adverse legislation in the instance of gas rates can be effected during the term of the present Governor. Mutual is buoyant, and inquired for at 177, and it would not surprise us to see this stock sell close to 200 before the year is out. Equitable is also very strong. The Brooklyn situation is in the same old state, with prices well up to every cent that the shares are worth. Chicago gas is only 5 points lower than it was a week ago, and indications are that bottom figures on the latest juggle have not been reached. It is a good stock to leave to the care of the professionals. Baltimore Consolidated is strong, at 64 to 64½, and Mr. Addicks has succeeded in "raising" Bay State to 21, plus, and Western gas, which looks to us to be a purchase, is quoted at 70 to 72. Quotations for the new securities of the Newark (N.J.) Gas Company have appeared. The bonds (6's) are 120 bid, and the stock is bid for at 75.

Gas Stocks.

Quotations by Close & Nash, Brokers and Dealers in Gas Stocks.

35 WALL ST., NEW YORK CITY.

OCTOBER 14.

☞ All communications will receive particular attention.
☞ The following quotations are based on the par value of $100 per share.

N. Y. City Companies.	*Capital.*	*Par.*	*Bid.*	*Asked.*
Consolidated	$35,430,000	100	144¼	145
Central	500,000	50	150	..
" Scrip	220,000	..	100	..
Equitable	4,000,000	100	197	199
Bonds, 6's	1,000,000	1,000	105	..
" 1st Con. 5's	2,300,000	1,000	114	..
Metropolitan Bonds	658,000	..	108	112
Mutual	3,500,000	100	177	..
" Bonds	1,500,000	1,000	100	102
Municipal Bonds	750,000	..	..	.
Northern	150,000	50	80	81
" Bonds	150,000	1,000	..	98
New York and East River	5,000,000	100	31	32½
Preferred	2,000,000	100	54	56
Bonds	3,500,000	1,000	95	96
Richmond Co., S. I.	348,650	50	50	..
" Bonds	100,000	1,000	..	..
Standard	5,000,000	100	68	69
Preferred	5,000,000	100	107	..
Bonds, 1st Mortgage, 5's	1,500,000	1,000	119	..
Yonkers	299,650	50	112	..
Gas Co's of Brooklyn.				
Brooklyn	2,000,000	25	125	..
Citizens	1,200,000	20	65	..
" S. F. Bonds	320,000	1,000	..	101
Equity	2,000,000	10	..	..
" Bonds	1,000,000	..	..	..
Fulton-Municipal	3,000,000	100	175	..
" Bonds	300,000	..	103	..
Peoples	1,000,000	10	90	.
" Bonds, 7's	368,000	..	100	..
" " 6's	94,000	..	98	100
Metropolitan	870,000	100	170	..
" Bonds, 5's	70,000	..	..	..
Nassau	1,000,000	25	225	..
" Ctfs	700,000	1,000	99	100
Williamsburgh	1,000,000	50	210	..
" Bonds	1,000,000	..	107	110
Out-of-Town Companies.				
Bay State	5,000,000	50	21	21¼
" Income Bonds	2,000,000	1,000	..	30
Boston United Gas Co.—				
1st Series S. F. Trust	7,000,000	1,000	78	80
2d " " "	3,000,000	1,000	53½	..

Buffalo Mutual	750,000	100	125	..
" Bonds	200,000	1,000	95	100
Central, San Francisco	.....	..	95	..
Chicago Gas Co.	25,000,000	100	67¼	67⅛
Chicago Gas Lt. & Coke Co. Guaranteed Gold Bonds.	7,650,000	1,000	94	94¼
Columbus	1,069,000	..	63	66
1st Mortgage	1,085,000	..	91	98
Consumers, Jersey City	2,000,000	100	92½	..
" Bonds	600,000	1,000	102¼	.
Cincinnati G. & C. Co.	7,000,000	100	202¾	203
Consumers, Toronto	1,600,000	50	184½	187
Capital, Sacramento	.....	.	..	41
Consolidated, Baltimore	11,000,000	100	64	64¾
Mortgage, 6's	3,000,000	..	107	107⅛
Chesapeake, 1st 6's	1,000,000	..	..	..
Equitable, 1st 6's	910,000	..	..	..
Consolidated, 1st 5's	1,490,000	..	..	..
Detroit	4,000,000	..	29½	30¼
" Con. Bonds	4,812,000	..	75	..
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1,000	..	101
Fort Wayne	2,000,000	..	72	74
" Bonds	2,000,000	..	84	86
Hartford	750,000	25	130	135
Indianapolis	2,000,000	..	147	150¼
" Bonds, 6's	2,650,000	..	106	..
Jersey City	750,000	20	180	..
Lafayette Gas Co., Ind.	1,000,000	100	83	85
Bonds	1,000,000	1,000	87½	89½
Louisville	2,570,000	50	..	130
Laclede, St. Louis	7,500,000	100	28¼	28⅝
Preferred	2,500,000	100	85	87
Bonds	9,084,400	1,000	97¼	97⅜
Little Falls, N. Y.	50,000	100	..	100
Bonds	25,000	..	..	100
Montreal, Canada	2,000,000	100	200	..
New Haven	.....	25	225	..
Oakland, Cal.	.....	..	46½	..

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Ludlow Valve Manufacturing Co., Troy, N. Y. 630
Chapman Valve Manufacturing Co., Boston, Mass. 630
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Isbell-Porter Co., New York City 638
The Western Gas Construction Co., Fort Wayne, Ind. 630

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OFFICE LOUISVILLE GAS CO.,
LOUISVILLE, KY., Oct. 9, 1895.

Proposals will be received until noon of Nov. 15, 1895, for the Coal Tar produced at these works on a basis of one, three or five years. Particulars as to quantity, facilities, etc., may be had on application to the undersigned.

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WANTED,

Second-Hand Six-Inch Exhauster,

with Automatic Governor and Engine complete. State condition of same and lowest price.

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WANTED,

First Mortgage Loan of $6,000 on a Modern Gas Plant in New Jersey worth $30,000.

Money to be used to pay for new apparatus and to extend mains to new and large consumers. Address "TRUSTEE,"
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DIVIDEND NOTICE.

OFFICE OF THE UNITED GAS IMPROVEMENT CO., 813 DREXEL BUILDING, PHILA., Sept. 26, 1895.

The Directors have this day declared a quarterly dividend of 2 per cent. ($1 per share), payable on Oct. 15, 1895, to stockholders of record at the close of business Sept. 30. Checks will be mailed. EDWARD C. LEE, Treas.

Position Desired

By a man 21 years of age, who has had considerable experience in the Coal and Water Gas business. Can take meters, make connections, set meters, lay mains, put in services and stoves, and do any kind of work about a gas works. Best of references. Address
1059-4 "B. R. D.," care this Journal.

POSITION WANTED

As Supt. or Manager of a Gas Works or Gas and Electric Light Works.

Fifteen years' experience as Manager of Gas Works and six years Gas and Electric Light Works. Good reasons for wishing to change present employment.
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WANTED,

By a man who has had a round experience in the manufacture and sale of gas,

A Position as Supt. of a Large or Small Gas Works.

Is capable and energetic, and is willing to begin at a moderate salary. Address
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Four 10-inch Ludlow and Two 6-inch Smith & Sayre Valves.

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NO EXTRA LABOR OR OPERATING EXPENSES.

Ammonia Concentrator,

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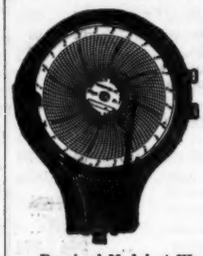

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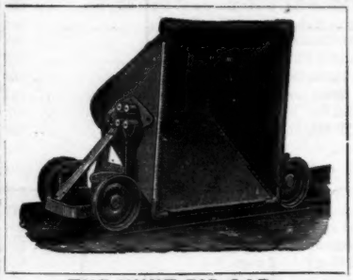

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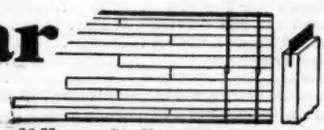

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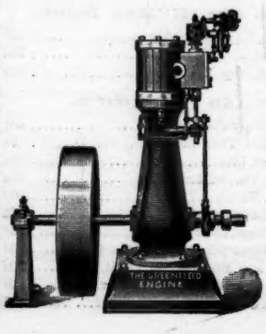

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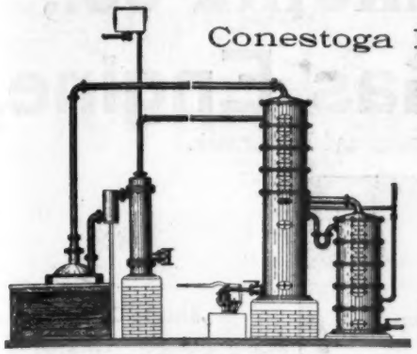

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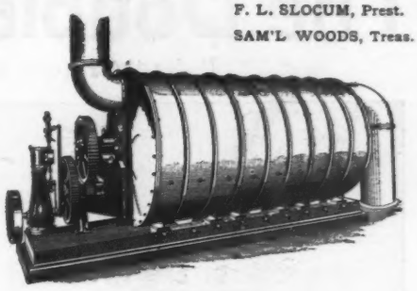

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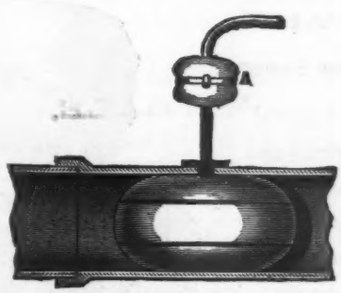

These Gas Bags are used to stop the flow of gas while repairing or making alterations in gas mains. There have been numerous cases of workmen being badly injured, and sometimes fatally, by the escape of gas resulting from the bursting of a bag, and our patent improvement is designed to obviate such calamities. The indicator *A* shows unerringly when the bag has been sufficiently inflated to pack the main, and when the pumping should be stopped. Our Bags are made of a rubber stock especially prepared to admit of great distension, and to resist the action of Oils, Gases, Naphthas and other residuum in the mains, and they are made with lapped joints, which adds greatly to their strength.

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5 "	"	"	1.05	20 "	"	"	12.00
6 "	"	"	1.75	24 "	"	"	17.00
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The Double-Acting Gas Engine,

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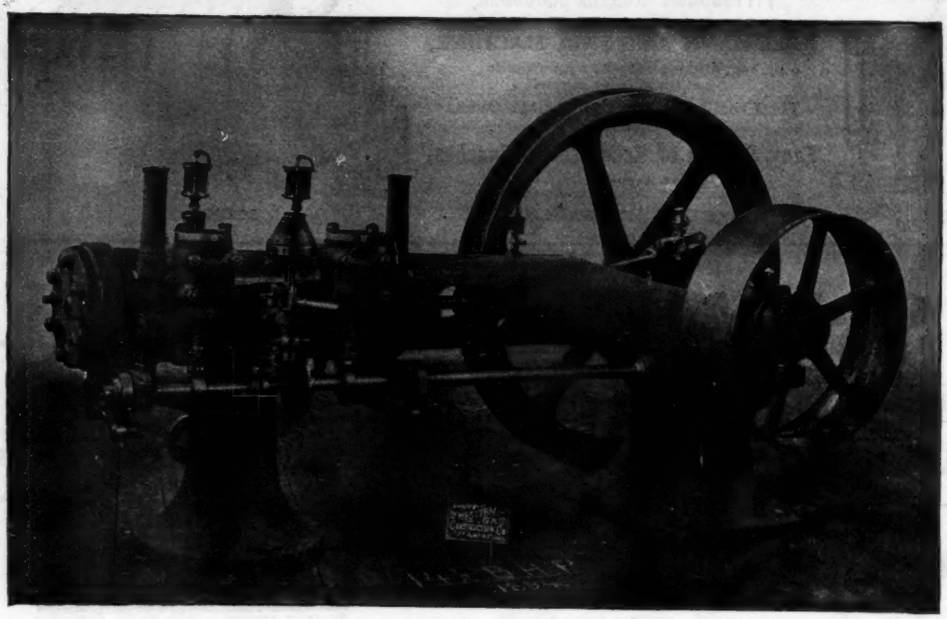

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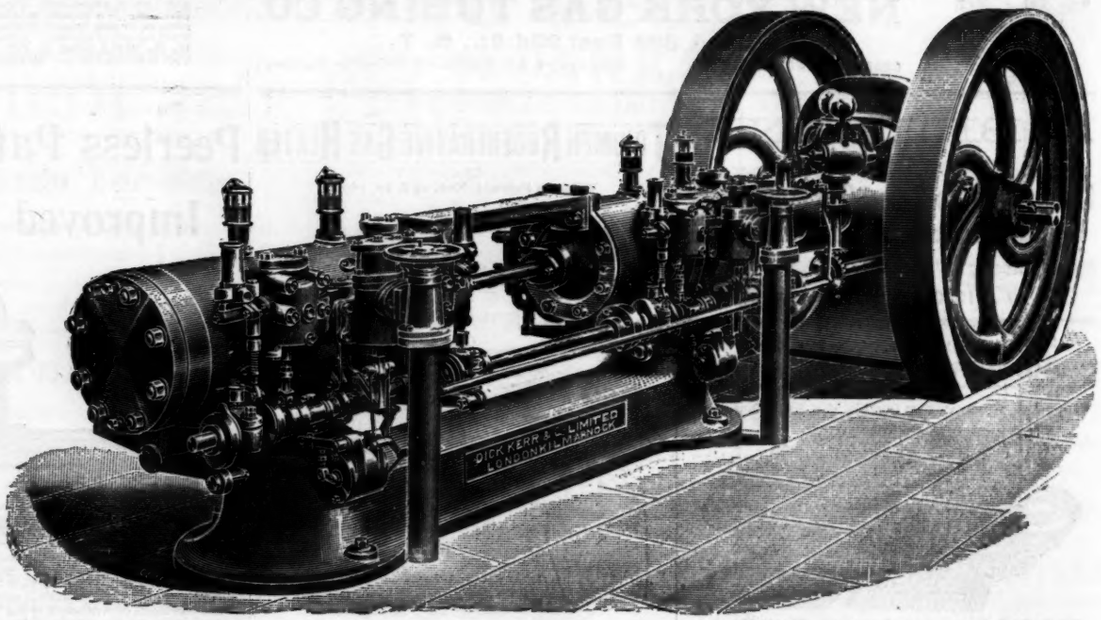

ESSENTIAL PRINCIPLE.—An impulse at each end of piston; using half force to each impulse; doubling the steadiness; reducing the wear on moving parts, and weight for given power. **CONSTRUCTION.**—The piston rod works through stuffing box in front end of cylinder, and connecting rod is carried in a cross-head working in a slide in frame, as in ordinary steam engine practice. All valves are of the poppet type, operated by cams on a single cam-shaft, giving positive movement to every working part. Tube or electric ignition. **RESULT.**—An engine of extreme simplicity and steadiness of action, the even wear on the cylinder and all working parts assuring increased economy, long life, and minimum cost in repairs. **RECORD.**—Successful and constant use in Great Britain for the past eight years. Address

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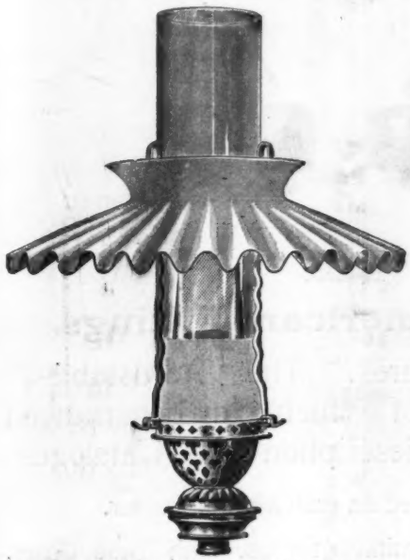

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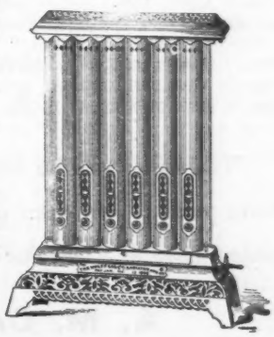
The Trilby uses less gas and gives more and better heat than any other Gas Radiator in the market.



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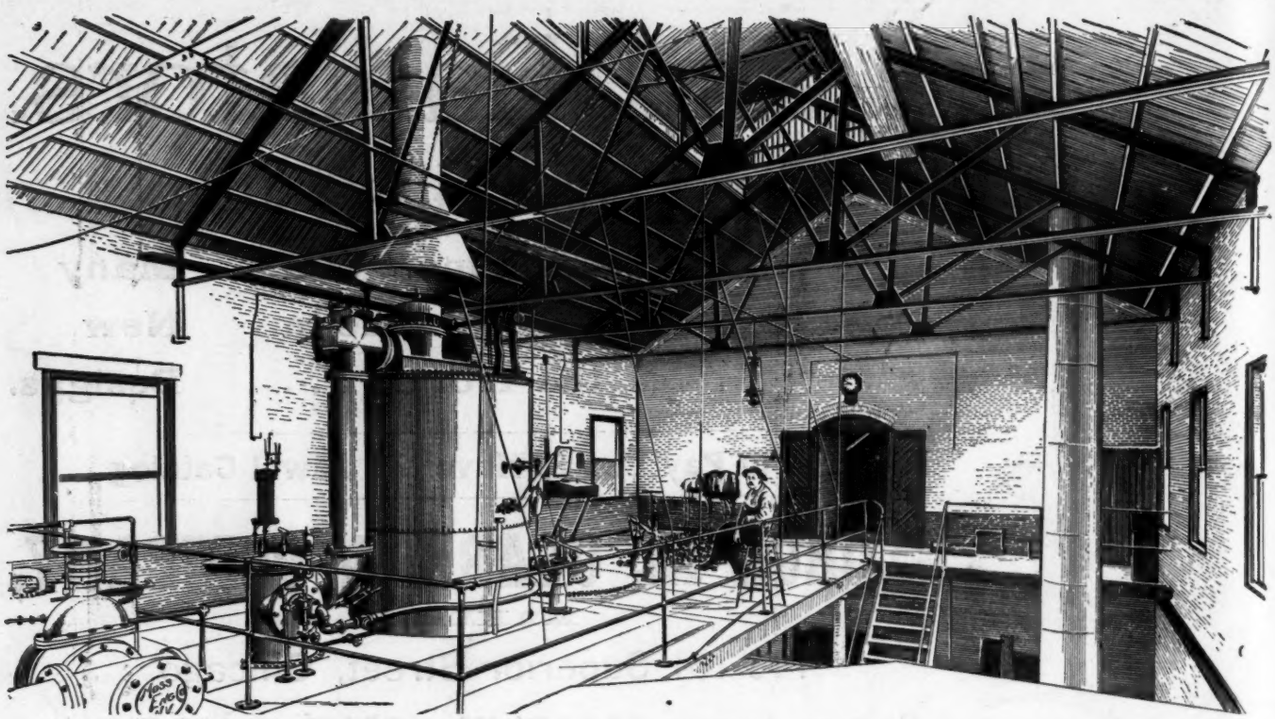

The above illustration is taken from a photograph, and shows the Machine Room of the New Bedford Gas Co., at New Bedford, Mass. The Roof on this building was furnished by us. The building is 32 feet in width by 50 feet in length, the Roof being made entirely of iron—that is, iron trusses and iron purlins covered with corrugated iron. The room is ventilated by a wrought iron ventilator extending the full length of the building, with corrugated shutters on each side opening and closing by cords from the floor.

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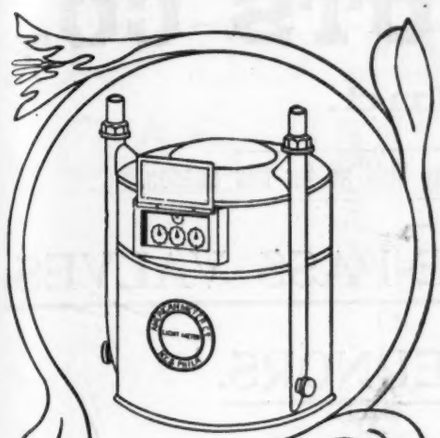

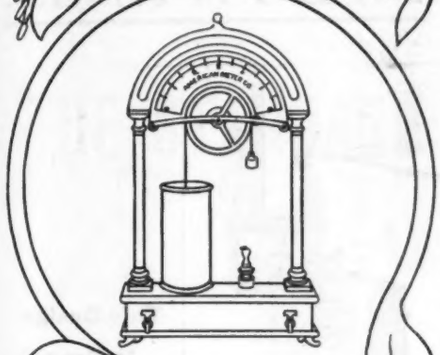

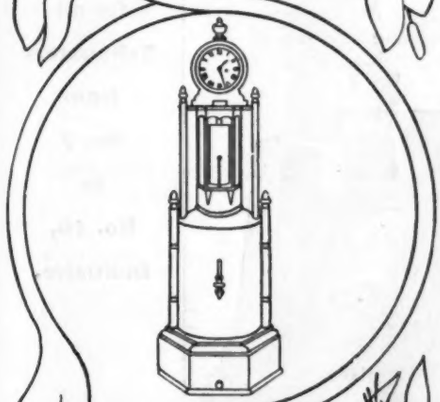

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SAN FRANCISCO.

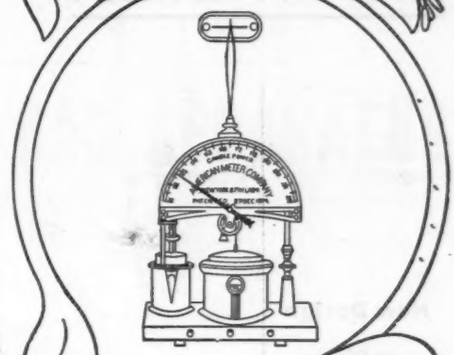
PUBLIC LIGHTING TABLE.

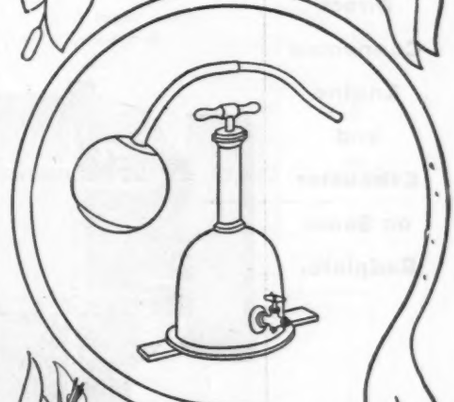
OCTOBER, 1895.

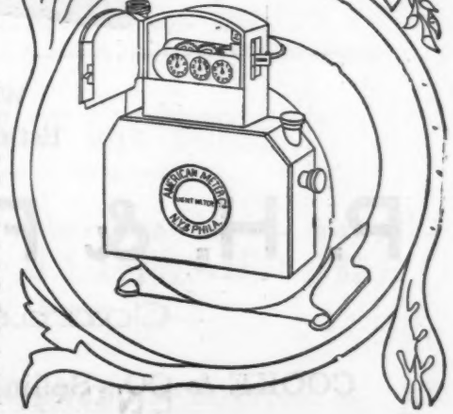
Day of Week.	Date.	Table No. 1. Following the Moon. Light.	Table No. 1. Following the Moon. Extinguish.	Table No. 2. New York City. All Night Lighting. Light.	Table No. 2. New York City. All Night Lighting. Extinguish.
				P.M.	A.M.
Tue.	1	3.40 AM	5.00 AM	5.30	5.00
Wed.	2	No L.	No L.	5.30	5.00
Thu.	3	No L. FM	No L.	5.30	5.00
Fri.	4	No L.	No L.	5.30	5.00
Sat.	5	6 00 PM	7.10 PM	5.30	5.00
Sun.	6	6.00	7.40	5.30	5.00
Mon.	7	6.00	8.10	5.30	5.00
Tue.	8	6.00	8 50	5.20	5.10
Wed.	9	6.00	9.50	5.20	5.10
Thu.	10	6.00	10.50	5.20	5.10
Fri.	11	6.00 LQ	12.00 AM	5.20	5.10
Sat.	12	6.00	1.20	5.20	5.10
Sun.	13	5.50	2.30	5.20	5.10
Mon.	14	5.50	5.10	5.20	5.10
Tue.	15	5.50	5.10	5.10	5.20
Wed.	16	5.50	5.10	5.10	5.20
Thu.	17	5.50 NM	5.10	5.10	5.20
Fri.	18	5.50	5.10	5.10	5.20
Sat.	19	5.50	5.10	5.10	5.20
Sun.	20	5.40	5.20	5.10	5.20
Mon.	21	5.40	5.20	5.10	5.20
Tue.	22	7.10	5.20	5.00	5.30
Wed.	23	8.20	5.20	5.00	5.30
Thu.	24	9.20	5.20	5.00	5.30
Fri.	25	10.20 FQ	5.20	5.00	5.30
Sat.	26	11.30	5.20	5.00	5.30
Sun.	27	12.30 AM	5.30	5.00	5.30
Mon.	28	1.30	5.30	5.00	5.30
Tue.	29	2.30	5.30	4.45	5.35
Wed.	30	3.30	5.30	4.45	5.35
Thu.	31	4.30	5.30	4.45	5.35

TOTAL HOURS LIGHTING DURING 1895.

By Table No. 1.	Hrs. Min.	By Table No. 2.	Hrs. Min.
January	237.00	January	423.20
February	196.40	February	355.25
March	195.50	March	355.35
April	165.30	April	298.50
May	153.40	May	264.50
June	138.20	June	234.25
July	146 30	July	243.45
August	152.50	August	280.25
September	165.10	September	321.15
October	186.10	October	374.30
November	204.10	November	401.40
December	219.30	December	433.45
Total, yr.	2161.20	Total, yr.	3987.45







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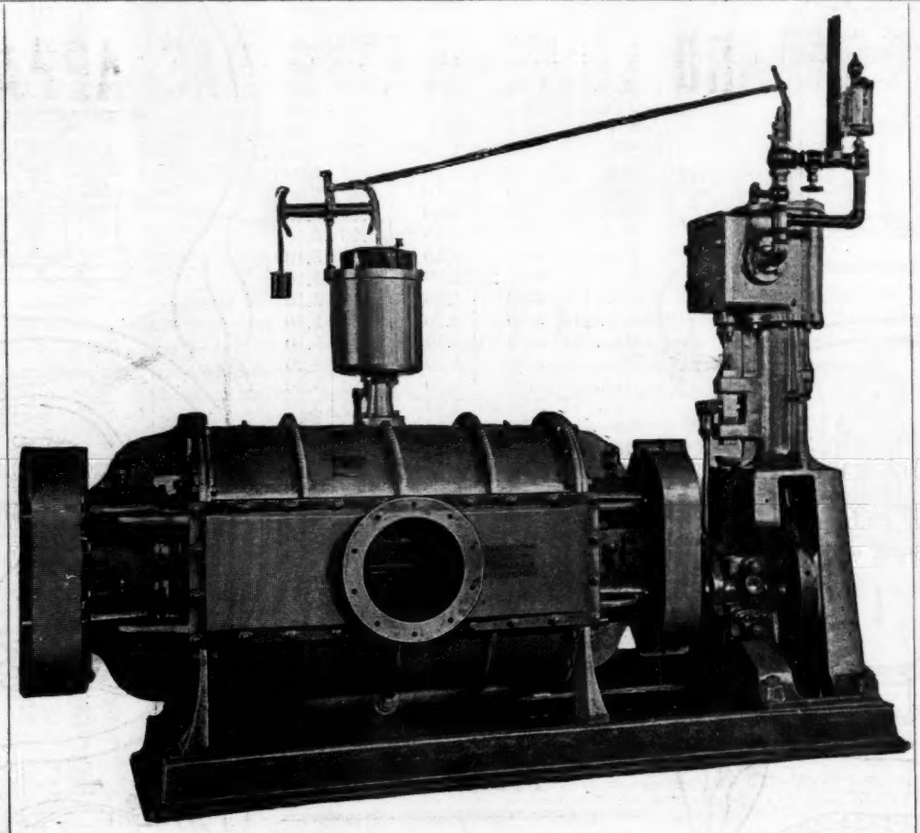

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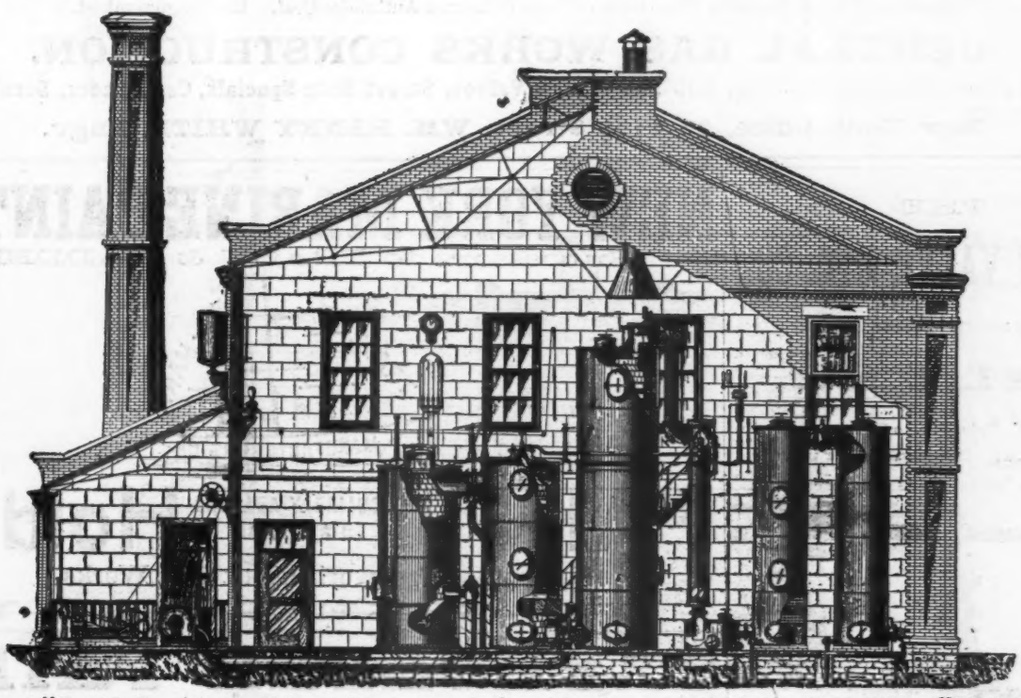

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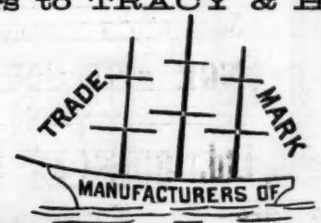

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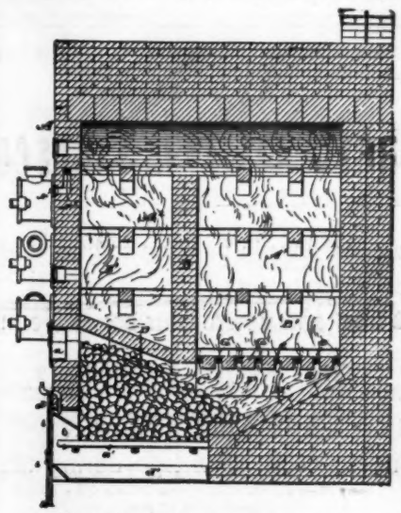

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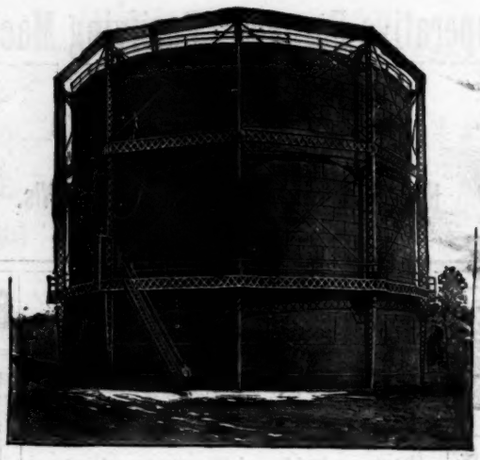

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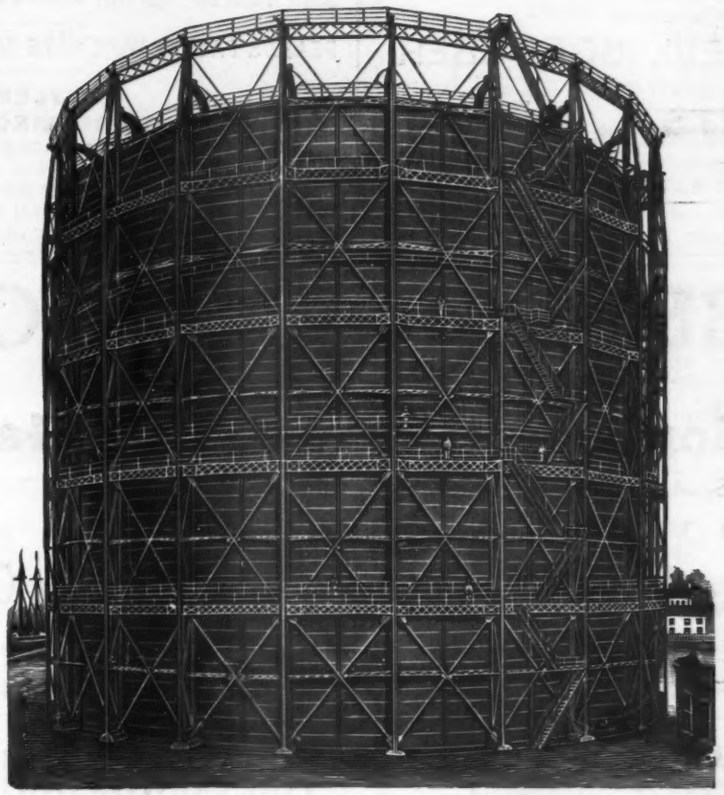

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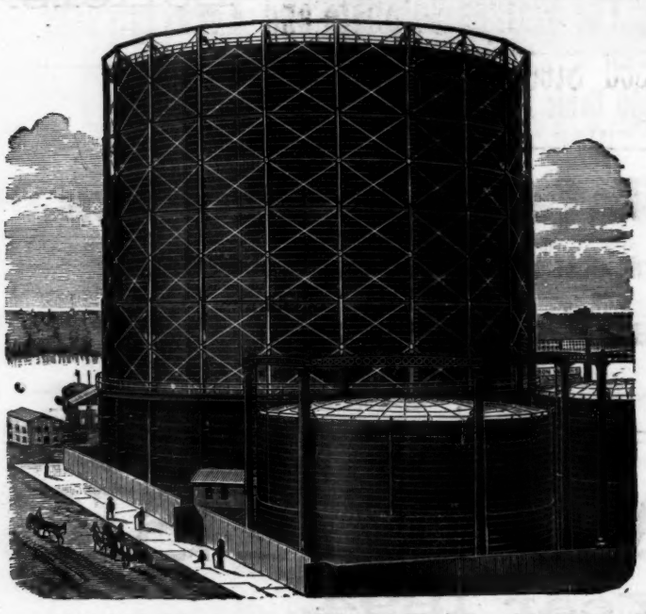

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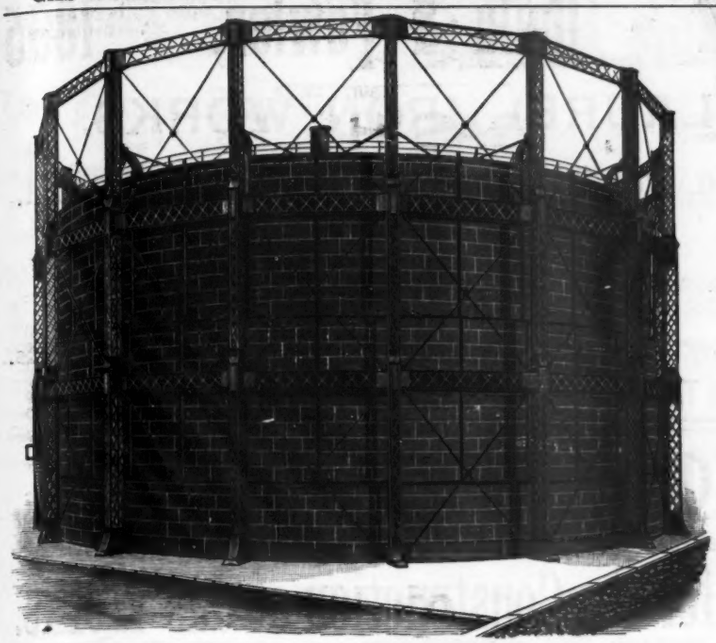

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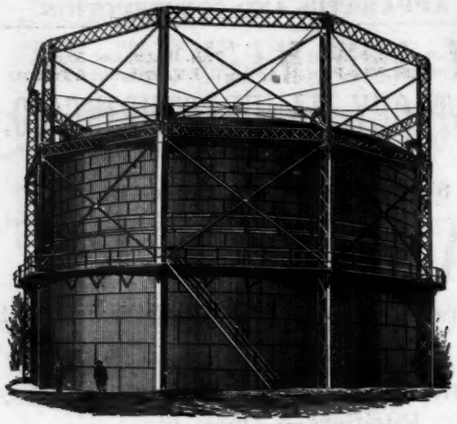

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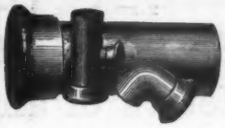
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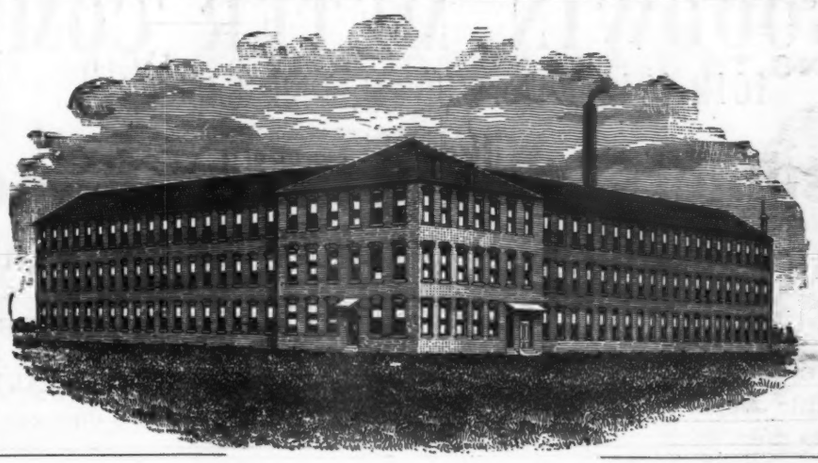

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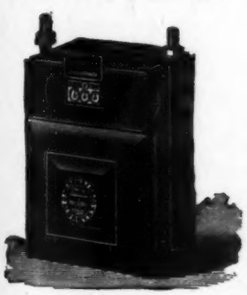

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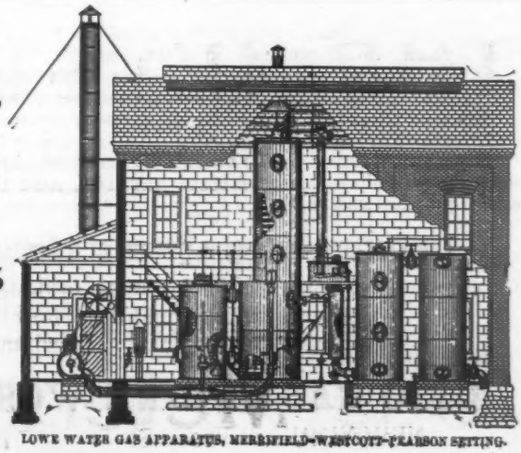

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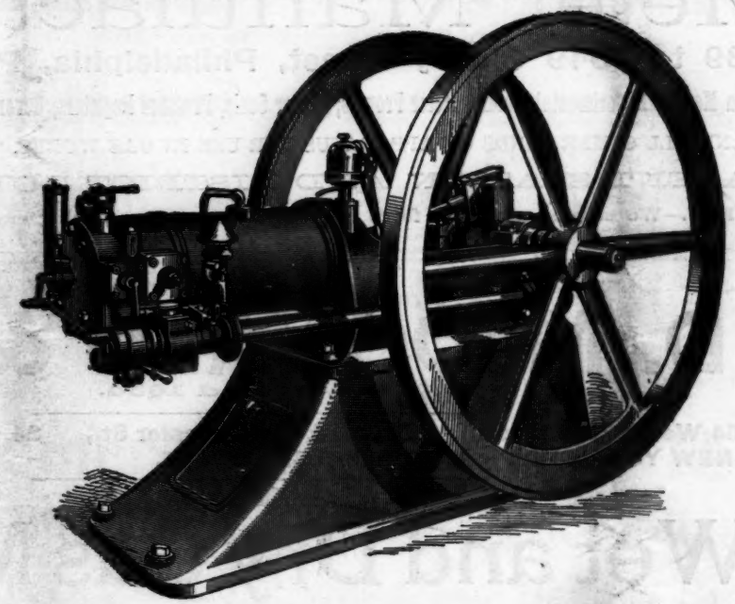

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